CHEMICAL
& METALLURGICAL
ENGINEERING
ESTABLISHED 1902

CONTENTS

VOLUME 48 JANUARY, 1941 NUMBER 1

S. D. KIRKPATRICK, *Editor*
JAMES A. LEE, *Managing Editor*
THEODORE R. OLIVE, *Associate Editor*
M. A. WILLIAMSON, *Publisher*
HENRY M. BATTERS, *Market Editor*
MELVIN E. CLARK, *Assistant Editor*
LESTER B. POPE, *Assistant Editor*

EDITORIAL REPRESENTATIVES

PAUL D. V. MANNING
68 Post St., San Francisco, Calif.
E. S. STATELER
520 N. Michigan Ave., Chicago, Ill.
R. S. McBRIDE
712 Jackson Pl., Washington, D. C.
EARLE MAULDIN
1011 Rhodes-Haverty Bldg., Atlanta, Ga.

Chem & Met

NEXT MONTH

When in September, 1939, *Chem & Met* published its second edition of "Facts and Figures of the American Chemical Industry," it was with the promise that these basic data would be kept up-to-date through frequent revision. Practical completion during 1940 of the biennial Census of Manufactures provides us with timely and official statistics to supplement the commodity and distribution studies that will feature *Chem & Met's* 18th Annual Review Report.

PAGE NUMBERS: An innovation for 1941 is CHEM & MET's new simplified system of page numbering. Henceforth the pages will be numbered consecutively from front to back cover in each issue regardless of whether they contain editorial or advertising matter. An italic number representing the publication month will be associated with each page number to facilitate reference. For example, the first editorial page in this issue is page 1-71.

McGRAW-HILL
PUBLISHING COMPANY, INC.

Published monthly, price 35 cents a copy. Address all communications about subscriptions to the Director of Circulation, 330 West 42nd St., New York, N. Y. Subscription rates —United States, Canada, Mexico, Central and South American countries, $3 a year, $4 for two years, $5 for three years. All other countries, $5 a year, $10 for three years. Great Britain and British Possessions 30 shillings for one year, 60 shillings for three years. Entered as second-class matter, Sept. 3, 1936, at Post Office at Albany, N. Y., U. S. A., under the act of March 3, 1879.

—James H. McGraw, Founder and Honorary Chairman; James H. McGraw, Jr., President; Howard Ehrlich, Exec. Vice-President; Mason Britton, Vice-Chairman; B. R. Putnam, Treasurer; D. C. McGraw, Secretary; J. E. Blackburn, Director of Circulation. Publication office, 99-129 Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd St., New York, N. Y. Cable address Mcgrawhill, N. Y. Branch offices: 520 North Michigan Ave., Chicago; San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta. Member A. B. C. Member A. B. P.

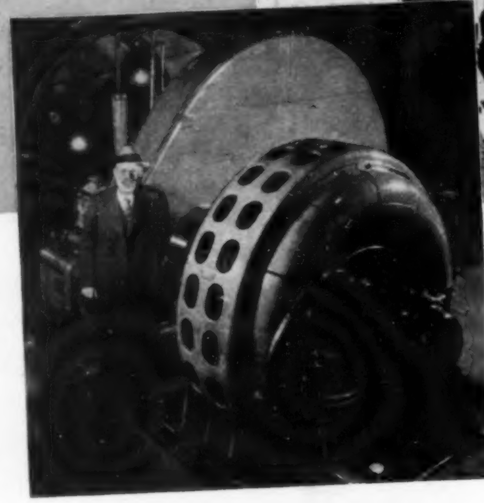
A McGRAW-HILL PUBLICATION

600 HORSES

FLATTEN THE HILLS OF SAN FRANCISCO!

Another true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

Yes! Two Allis-Chalmers 300-Horsepower Motors Operate San Francisco's Historic California Street Cable Car System Over Hills as Steep as 21%! What's More — They've Given 26 Years of Notable Day-After-Day Service . . . With Never A Motor Failure! Find Out How to Get This Same Type of Dependable, Low-Cost Motor Performance in Your Plant!



TWO ALLIS-CHALMERS 300-HORSE-power motors keep eleven miles of underground cable in steady motion 20 hours a day to operate the famous California Street cable cars. Shown here with one of the motors is 86-year old James W. Harris who recently retired as president of the company.

YOU GET a different kind of a street car ride in San Francisco . . .

As part of the picturesque background of this colorful city, cable cars climb hills that would balk ordinary trolley cars . . . grades as sharp as 21%! And down under the tracks are moving continuous cables . . . eleven miles of them . . . kept going at a steady pace of 8½ miles per hour by two Allis-Chalmers 300-Hp Lo-Maintenance Motors located at the central station.

No Motor Failures In 26 Years

There's a fascinating story here. Built by Governor Leland Stanford in 1878 . . . destroyed in the earthquake and fire of 1906 . . . the California Street Cable Railroad occupies a unique place in municipal street transportation systems. But that's only part of it —

For the Allis-Chalmers Motors are doing a behind-the-scenes job that is equally interesting to every motor user. Providing power to operate 60,000 feet of underground cable . . . running an average of twenty hours a day . . . there's never been a motor failure with these motors since they were installed 26 years ago! Significantly, it's the same kind of dependable, long-life, low-cost service that Lo-Maintenance Motors have given in thousands of other industrial installations all over the country.

If this is the type of motor performance you want in your plant, get the facts about Lo-Maintenance Motors. The engineer in the district office near you will be glad to give you the information you want. Or you can write Allis-Chalmers, Milwaukee, Wisconsin.

A 13

Over 90 Years of Engineering Superiority Work for You When

ALLIS-CHALMERS

CHEMICAL
& METALLURGICAL
ENGINEERING

ESTABLISHED 1902 S. D. KIRKPATRICK, Editor

JANUARY, 1941

New and Heavier Responsibilities

THERE is hard work ahead for chemical engineers in 1941. Not since 1917 has our profession faced so great a problem in the expansion of industrial facilities to meet the tremendous demands for national defense. And this comes at a time when research and development departments are at peak activity awaiting only the opportunity to launch new enterprises of vast significance in our peace-time economy. So, more than ever before, we need careful planning and wise management to guide our energies and resources during the perilous but perhaps fascinating months ahead.

So far the full impact of the defense program has yet to reach the chemical process industries. Expansion of plants for explosives and other chemical munitions has barely begun. Withdrawal of man-power for military service has thus far caused only a negligible influence on employment. This means that our engineers and executives have still to face the major personnel problems that are already plaguing the aircraft, shipbuilding and machine tool industries.

But critical times are coming—and soon. The huge defense plants now under construction will require thousands of technically trained men. Hundreds more will be needed in new plant facilities required for much greater production of the ordinary chemicals of commerce. Government inspectors, preferably chemically trained, will be needed by the thousands. Within six or eight months there is certain to be a mad scramble for college graduates and all employable chemists and chemical engineers. The ranks of the Class of 1941 will be quickly depleted for it is even smaller in proportion to the demands for men than have been most of its predecessors.

Evidently the graduate crops of future years will be smaller still. One chemical executive reports: "Man after man whom we have interviewed says he is stopping his undergraduate training at the four-year B.Sc. stage instead of going on with graduate work for M.Sc. or Ph.D. degrees—simply because he may have passed the minimum draft age. Obviously the outcome is going to be not only a shortage of available technically trained men, but also a shortage of men in graduate training in the future."

Where, then, are our industries to get the needed personnel for their expansion programs? To take them away from research and development departments, as unfortunately has been happening all too often of late, is merely robbing Peter to pay Paul. National defense needs research almost as badly as it needs production and, if our industries are to survive, most of our long-time research programs must be continued. So the problem eventually comes down to the vital necessity

for providing some kind of training and up-grading of men for new and heavier responsibilities.

Governmental agencies are working on this problem. They are first trying to find out how big are the needs and then to aid the industries in finding and training the men to fill these needs. Unfortunately there are many other industries harder hit than we are—at present at least. The immediate personnel problems of the airplane and airplane motor manufacturers, the machine tool and shipbuilding industries, are largely monopolizing the limited time and facilities of the various governmental agencies. We shall have to stand in line and take our turn.

The unfortunate part of this situation is that when the government gets around to our problem it may be too late. It takes from four to eight years to give a man adequate training in chemistry or chemical engineering and obviously that training cannot be replaced by any hothouse courses in government-sponsored vocational or apprentice programs. These may help somewhere down the line, but in our opinion the problem will not be solved until industry itself takes the leadership. Each employer must analyze his own personnel problems and project them ahead to September, 1941, and January, 1942. He must make provision to train and develop his own technical men—from green college graduates, from foremen and supervisors, from bright high school boys and from the ranks of plant labor.

In doing this job, the Federal Government is willing and anxious to help. There are now three national defense educational programs in operation. One will help to make technicians by providing high-grade vocational training in existing schools. Another will assist with so-called "refresher" courses for specialized training of college grade. The third, through the "training within industry" services of the National Defense Advisory Commission, will assist industrial firms in establishing training facilities and courses within their own plants.

Any chemical enterprise which anticipates the shortage of a certain type of workers should take this matter up with nearby colleges or vocational schools, as the case may require. These institutions know how to obtain the necessary financial assistance from the government so that those who should be trained can be served without tuition. They would welcome the interest and cooperation of neighboring industries for they, too, realize the seriousness of this problem. It will take a minimum of three to nine months to give specialized training in only a few engineering procedures. It's time to get started.

"Chemical Man-Power for Defense" is the No. 1 problem in 1941 for the chemical engineering profession. It's also No. 1 of *Chem. & Met.'s* 1941 reports to its readers. (See pages 95 to 102 of this issue.) It will pay you to read and study that report most carefully.

SPEED WITH SAFETY

So far, with relatively minor exceptions, the equipment manufacturers have not held up any important construction projects in chemical process industries. Deliveries of certain castings and heavy forgings have been slower than anticipated due to the very pressing demands of the airplane industry and for naval construction. We have heard no complaints on quality. Some plants report shortages of steel workers, pipe-fitters and skilled mechanics—due again to competition from the shipyards and machine shops. Nevertheless a visitor to any of the great new centers of chemical activity—Memphis, Tenn., Freeport and Texas City, Tex., Carlsbad, N. M., Charlestown, Ind., to mention but a few—is impressed not only with the speed with which these plants are expanding, but also by the enviable safety records that have been established by the construction crews.

Last year chemical industry suffered a series of most regrettable accidents. None, so far as we have learned, has been directly traceable to industrial sabotage. But these dangers are with us as well as the hazards that come from rapidly expanding operations and the breaking in of new workers. Accident records for chemical industry, both in frequency and severity, must be brought back again to the levels that we were so proud to maintain prior to 1940. This can be done only if there is wise planning and eternal vigilance in guarding every hazardous operation *plus* wise planning and eternal vigilance on the part of every plant employee.

GROWING PAINS

Many engineering colleges seem to be suffering from growing pains. We refer to the institutions themselves, not the students. And particularly, we refer to the departments of chemical engineering and the deans who have to worry about them.

A fundamental division of engineering which is as important as chemical engineering has grown to be within the past 20 years, naturally offers something of a problem. During the past five years many institutions have been compelled to add greatly to their faculties, laboratory space and other facilities in order to meet the demand. Unfortunately, budgets of these schools have not been as elastic as are the ambitions of the youths seeking training.

It is not desirable for too many schools to try to teach chemical engineering. But those who try should do a good job regardless of cost. Sometimes the other divisions of the engineering college must step aside, at least temporarily, to let this newcomer division catch up in space, equipment and faculty man-power.

No older department willingly gives up any of these things to a newcomer; but some deans whom we know will have to see that chemical engineering does get help even if it may seem to be at the tem-

porary expense of older departments. Otherwise they cannot expect to do as good a job of teaching in this new field as they are doing in others. To them particularly we suggest "either do it well or don't do it at all." You might even call this New Year's Resolution No. 1 for engineering deans.

FOREIGN ENTANGLEMENTS?

For many years it has been customary for many chemical process industries to exchange ideas with foreign enterprises of comparable sort. Had other divisions of society been as ready to establish a cultural exchange as were business men, there would be less international strife today. But it is important now to emphasize another aspect.

Many of these exchanges of ideas have resulted also in exchanges of patents and in important agreements permitting development of foreign inventions as well as the sale abroad of American processes and products. Now there are some in public life who look with critical skepticism at these "deals." They are inclined to criticize, even to legislate against them.

On the whole, American enterprise and the American public have gained greatly from international exchange of patents. This has given us many improvements and some substantial profits. Perhaps we cannot now continue actively to exchange our latest technical advances with several nations of the world. But there is no reason for being unduly critical of past arrangements entered into for the common good of the industry and of the United States. We have profited initially too much by these dealings to regard them as anything but good for the general welfare.

Retroactive legislation or punitive review of such business arrangements should not be undertaken by the legislator or public official before he looks carefully into the facts of each case. There may be some few important arrangements which are not in the public interest and which well could be abrogated or set aside. But by and large a thoughtful official will find much good and little evil in the so-called "foreign control" of American industry. We suspect that other foreign governments could rightly worry much more about American influence on their enterprises because American ingenuity and leadership have given to other parts of the world far more than we have taken from them. And no present American business of any consequence suffers seriously by the residue of foreign control that still remains.

OUR PLANS AND YOURS

Gratified by the enthusiastic reception our readers have given *Chem. & Met.'s* monthly reports on economic, technical and professional problems, we plan to continue and enlarge on them through 1941. "Chemical Man-Power for National Defense," referred to elsewhere, seems an appropriate beginning for the present series. *"Chem. & Met. Pictured Flowsheets,"* now in their third successful year, are being used (and not always with our permission) by all who recognize the value of these technical visualizations of interesting chemical engineering processes and equipment. Two new editorial departments, to abstract and report significant papers presented at meetings and conventions and those appearing in current literature at home and abroad, will provide additional service to our readers. And, for everybody's convenience, a new and simplified system of pagination giving both months and page numbers should help you to find these features more readily in 1941.

And now how about your plans? Production in the domestic chemical consuming industries is at an all-time high record. Reflecting vastly greater needs both in Britain and South America, exports of industrial chemicals for the first 11 months of 1940 more than doubled the average rate of shipments for the same months in 1936 to 1938. Despite the sharp upturn in the last four months of 1939, the same months of 1940 are expected to have shown an increase of at least 50 percent.

But just because business is pushing ahead, none of us can afford to sit back and rest on the oars. There is work to be done. National defense and aid to Britain must have precedence, but to make sure we have a business and profession after this is over, somebody must be doing a lot of thinking and planning for the long-time future. It is a job every mature chemical engineer and executive can approach with energy and enthusiasm. Chemical engineering is still, in the words of the late John Hays Hammond, the "engineering of the future."

Sidney D. Kirkpatrick

Volume 48—Chemical & Metallurgical Engineering—Number 1

Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January, 1905, when it was changed to *Electrochemical & Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron & Steel Magazine*, which had been founded eight years previously by Dr. Albert Sauveur. In January, 1910, the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the present title was assumed and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March, 1925.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death on Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and Sidney D. Kirkpatrick was appointed editor.

The present editorial staff of the magazine comprises, in addition to Mr. Kirkpatrick: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive, associate editor, Melvin E. Clark and L. B. Pope, assistant editors. R. S. McBride, Paul D. V. Manning, E. S. Stateler and Earle Mauldin are editorial representatives in Washington, D. C., on the Pacific Coast, in Chicago, and in Atlanta, respectively.

Liquefying Natural Gas for Peak Load Supply

R. W. MILLER *Research Director, Hope and Peoples Natural Gas Cos., Pittsburgh, Pa.*

J. A. CLARK *Chief Engineer, Hope Natural Gas Co., Clarksburg, W. Va.*

Chem. & Met. INTERPRETATION

A novel chemical engineering method for storing large quantities of gas in liquefied form to meet public utility peak loads in Cleveland is here described. This radical departure from the usual city-gas practice was described by the authors before the natural gas section of the American Gas Association at its recent meeting. If this development can demonstrate its economic place in the industry, there is prospect of interesting new opportunities for chemical engineering practice in connection with natural gas supply for city and industrial use. Big-customer industry will be interested since such users often have to be cut off in times of peak load in order to conserve gas for household heating supply.—*Editors.*

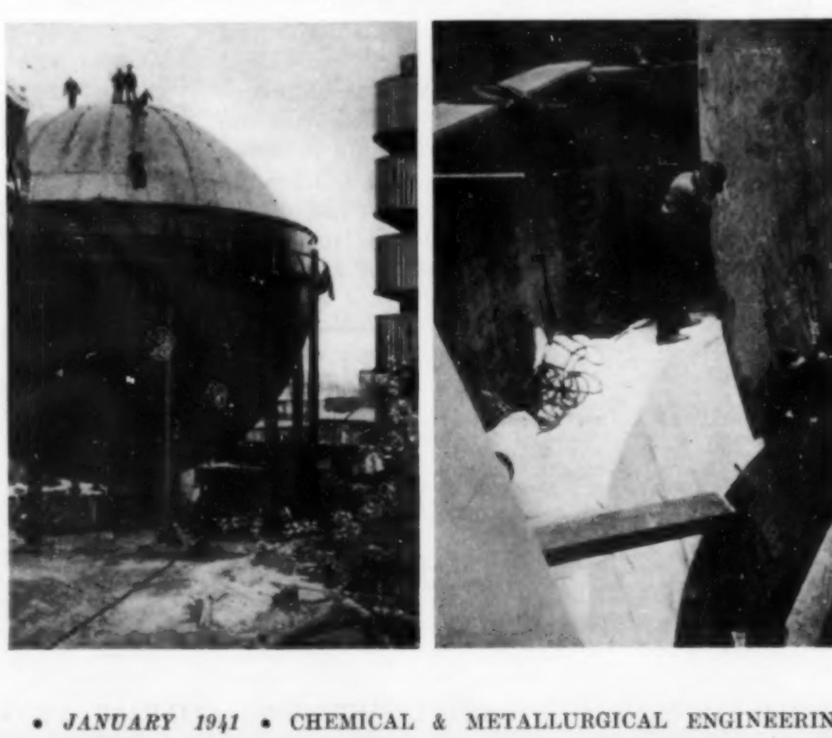
HOW TO MEET peak-load demands in the gas industry is a problem that has been before gas executives and engineers for many years. Natural gas companies have experienced greater difficulties in solving peak-load demand problems than those utilities distributing manufactured gas. The system is not called upon to deliver the amount of natural gas for which it was designed until the coldest days of the winter, when all available wells are turned into the gathering lines and all compressors are in use. If the cold spell is prolonged or extremely severe for three or four days, customer demand may equal or even exceed the capacity of the system to deliver. It is then that some extra gas, available from nearby storage, would indeed prove a boon to the utility.

Adequate storage of natural gas, however, presents a somewhat complicated picture. Generally speaking, the pipe line has been the gasholder of the natural gas utility. Natural gas has been stored in the pipe line by the simple expedient of raising pressures therein during the night to the limits allowable. The gas thus stored is available on the following day. But it has become increasingly evident that such a method is not entirely successful under all conditions, and must be supplemented or augmented by storage at or near the point of use.

[The authors describe also other attempts to meet the peak-load problem by high pressure storage, by repressuring of depleted gas fields near the consuming point, and other expedients that are either of limited applicability or high cost. They then proceed to explain how experimental work began in August, 1937, on the idea of liquefaction for storage with regasification in times of peak load.—Editor.]

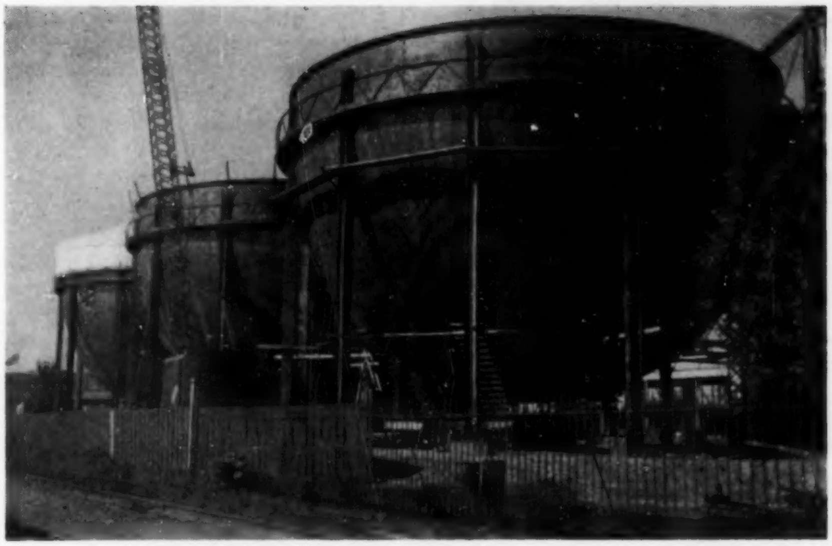
By September of 1939, research work had progressed sufficiently far in the laboratory to warrant the erection of a pilot plant, wherein relatively large quantities of natural gas could be liquefied, stored, and regasified, making use in a practical way of the methods developed on a

Storage spheres for liquefied natural gas during construction showing, at right, assembly of the inner sphere after insulation has been placed, and at left, inner sphere completed with upper half of outer sphere still to be constructed



Condensed from the paper presented by the authors at the Atlantic City meeting of the American Gas Association, Oct. 7-10, 1940.

Photos supplied through courtesy of the Gas Machinery Co. and Standard Oil Co. (N. J.).



Lower halves of outer shells completed, with cork insulation being installed; the tent over the third tank is for protection of insulation during construction

small scale, and whereby certain preconceived ideas could be tried out for the first time.

It was realized that early in cooling the gas for liquefaction, water and carbon dioxide would solidify and completely plug the tubes, so that these materials had to be removed at the very start of the process. For this, a scrubbing plant using mono-ethanolamine and diethylene glycol was first introduced, followed by two tanks filled with granulated aluminum oxide to remove the last trace of water vapor.

For storage, we used a horizontal symmetrical tank 10 ft. in diameter by 18 ft. long, holding 14,500 gal., equivalent to about 1,000,000 cu. ft. of gas. This was made of alloy steel plates and was covered with 2 ft. of formed cork, cemented on and water-proofed with bituminous tar.

The plant was completed and put into operation the middle of January, 1940. It took about four days running to chill all of the material before we began to get liquid gas, and then a three-day run gave us our first tank, 90 percent full. We then shut the engines down and let this tank stand to get the rate of heat infiltration and we found a daily evaporation of about 28,000 cu. ft. of free gas. Later, we built several evaporators and finally developed a design so that we could evaporate the liquid as fast as it was condensed, allowing us to run constantly for several weeks at a time and get actual operating conditions and data.

We arrived at the following conclusions from the operation of the pilot plant:

1. The last possible traces of water and carbon dioxide must be removed. Failure to hold up the amine concentration at one time caused a two-day shut down due to plugging with carbon dioxide ice.

2. There is a continual increase in the percent of nitrogen, oxygen or any other gas non-condensible at the low temperature and these must be continually removed. We found that a surge tank, inserted in the gas line just after the ethylene condenser, where the gas is a liquid at 600 lb., with a bleeder to the engine fuel line, solved this problem.

3. After going below —50 deg. F., the pipe and tank steel becomes so brittle it is entirely unsafe. The metals which retain a safe Charpy impact test value are, in the order of excellence, pure copper, bronze, Monel metal, red brass, stainless steel and steel plate with carbon content less than 0.09 percent and nickel over 3½ percent.

4. The best heat insulator we have found so far is cork, although something better may be discovered later. Formed cork was used on the pilot tank, but we found that loose granulated cork between two walls gave still better results and was much cheaper. However, this must be kept perfectly dry to function properly. We have found a conservative coefficient of heat transfer in B.t.u. per square foot per inch of thickness per deg. F. per hour to be 0.40.

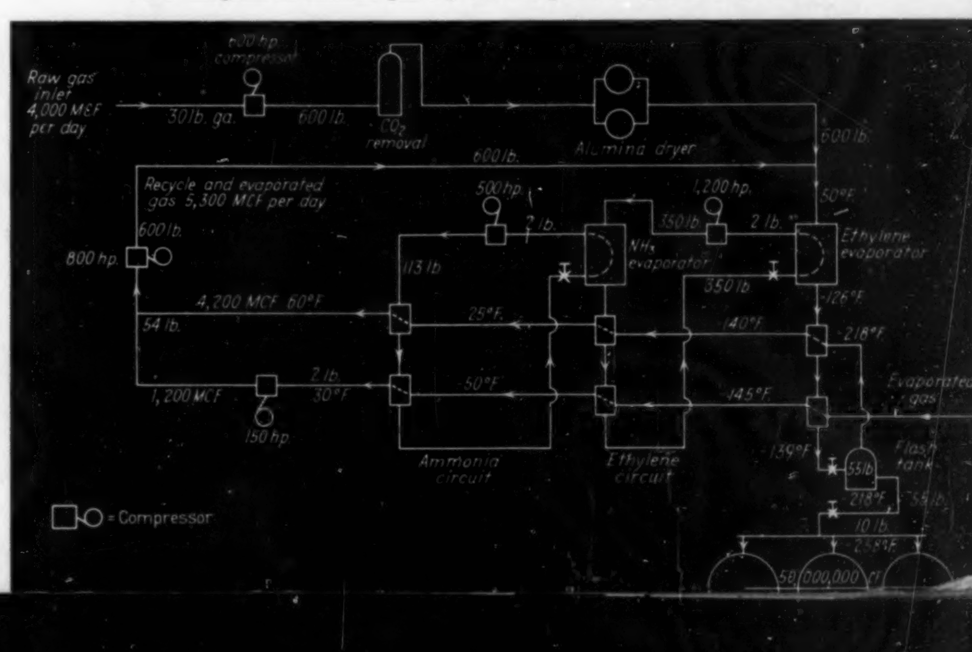
5. The evaporated liquid has exactly the same analysis as the raw gas used as feed. However, the evaporation from the stored liquid is entirely methane and eventually if allowed to stand for long periods, the liquid left will become increasingly higher in ethane-plus content.

6. At —250 deg. F the molecular activity of the liquid is so low that it is an excellent insulator for itself, and to transfer heat into it the liquid must be broken up into very thin layers and its velocity must be kept very high and turbulent.

After operating the pilot plant almost constantly for four months, it was found that practically all questions had been answered, and it was shut down and has since been dismantled.

Very shortly, however, an opportunity presented itself to use the knowledge gained in these experiments for the city of Cleveland. Plans already made called for an extension of a 12-in. high-pressure line to the city limits at a cost of approximately $2,500,000. However, after reviewing the pilot-plant work done, and the plans and estimates based on these results, the officials of the gas companies involved decided that they could secure the same results by building a liquid storage plant at a cost of roughly $750,000. ?

Flow diagram of natural gas liquefaction plant for gas storage at Cleveland



Natural-draft cooling tower to supply cooled water for gas condensation

Authority was given by them to go ahead with the plans. It is expected that this plant will be ready to operate by late fall, so that operations can be started and the storage filled by Christmas, making it available for this winter's peaks.

This plant, which is shown on the accompanying flow diagram, will be able to condense 4 million cu. ft. of gas per day and will have three storage tanks, each of 600,000 gal. capacity, equal to 50 million cu. ft. of free gas, or a total storage of 150 million cu. ft. The evaporators, which are steam heated, have a capacity to regasify 3 million cu. ft. per hour.

The feed gas will enter the plant from a city belt line at 30 lb. ga., and will be compressed by a 600 hp. engine to 600 lb. ga., then going through the scrubbing plant to remove all water and carbon dioxide, after which it goes to the ethylene exchangers with high pressure gas on the inside and boiling ethylene on the outside, thereby chilling the gas to —126 deg. F., and reducing it to a liquid. After further chilling in the two flash gas exchangers to —139 deg. F., it is cracked through the first expansion valve into the first expansion tank at a pressure of 55 lb. ga. Here, about half of it remains as a liquid, and the remainder goes back to be recompressed and processed over again. The liquid from this tank is then cracked through the second expansion valve directly into the main storage tanks at a pressure of 8 lb. ga., about 85 percent of it remaining as a liquid for storage, and 15 percent going into gas and being recompressed.

The evaporated gas from the second stage, after passing through heat exchangers, is picked up and compressed to 55 lb. ga. by a 150 hp. compressor. Here it joins the evaporated gas from the first stage cracking, and the combined stream is taken by an 800 hp. engine and boosted to 600 lb. ga., being then put back into the raw gas feed stream. This evaporated gas is practically pure methane.

The ethylene is contained in a closed circuit, where it is compressed, using 1,200 hp. at the flowing rate of 7 million cu. ft. per day up to 340 lb. ga., and then is cracked through an expansion valve to 5 lb. ga., reducing the temperature to —145 deg. F., which is used to condense the high pressure gas.

The ammonia is also in a closed circuit, flowing at the rate of 3.75 million cu. ft. per day, and compressed by a 500 hp. engine to 113 lb. ga., and then expanded through a valve to 3 lb., reducing the temperature to —20 deg. F., which is used to condense the high pressure ethylene.

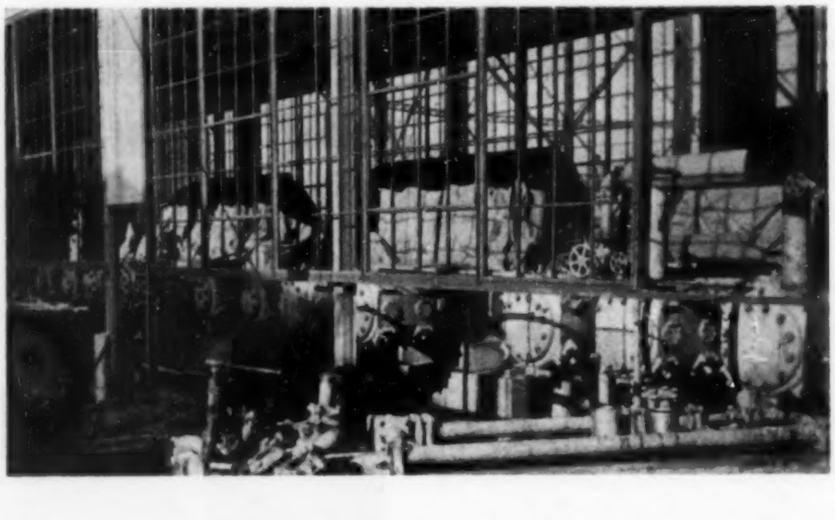
The storage tanks themselves are two concentric spheres separated by 3 ft. of cork insulation, formed in the lower half, to carry the load of the inner tank and its contents, and granulated in the upper half. The outer sphere is 60 ft. in diameter, made of tank steel and carried by legs down to a concrete footing. The inner tank is 54 ft. in diameter and supported entirely on the cork surrounding it. This tank is made of special steel with a 0.09 percent carbon and 3½ percent nickel content, and is of all-welded construction. In developing the welding technique, over 200 welding rods were tried to get one which would give a weld with a satisfactory Charpy impact test at —310 deg. F. the temperature of liquid nitrogen, and the one finally selected was high in nickel and chromium.

The evaporation equipment consists of three pumps that pick up the liquid from the tanks and raise its pressure to about 40 lb. ga., the city belt line pressure. The gas goes to a two-stage heat exchanger with gas on the inside of the tubes and steam on the outside. The first-stage heater has double tubes, the liquid passing first through a ¾-in. tube and then back between it and a 1-in. tube, exposing a very thin, high-velocity stream to the heat. Thereby is added the heat of vaporization and the gas leaves at about —200 deg. F. From the steam heater, it goes to a final four-pass gas heater, where its temperature is raised to about 30 deg. F., before being passed through meters to the distribution lines.

The remainder of the plant consists of conventional water cooling towers, water pumps, air compressors, and the other usual appliances of a gas compressing station.

All gas connections for normal temperatures are Van Stone on seamless steel pipe, with ring-joint gaskets. However, any line carrying gas or liquid colder than —50 deg. F. is made of copper tubing with Van Stone joints, using bronze flanges and bolts. At every point possible, automatic controls have been used to regulate pressure, temperature, volume, or engine speed so that the finished plant will have a minimum of manual supervision. Being in the heart of a large city, noise would be very objectionable, so all intakes and exhausts have been equipped with the best mufflers possible to obtain.

Compressors during installation: initial compression of the gas to 600 lb. is followed by re-compression of flashed gas



This is the way Carlsbad's newest potash mine and refinery appeared to the writer from a Continental Airliner on Dec. 15, 1940. Here the double sulphate of potash and magnesium is mined, refined and reacted with the muriate to yield a promising new source of K_2SO_4

Sulphate of Potash Produced From Langbeinite

S. D. KIRKPATRICK Editor, Chemical & Metallurgical Engineering

SULPHATE OF POTASH, which became a "critical commodity" in this country with the cessation of European imports, is now produced commercially from langbeinite ore for the first time in the United States. The new mine and refinery of the Union Potash & Chemical Co. of Carlsbad, N. Mex., which began operations late in September, shipped its first carload of sulphate of potash in November and has since greatly extended its production of this essential plant food for tobacco and other specialty crops. The double sulphate of potassium and magnesium, which was formerly available only from Europe, is also being shipped for application to citrus and other crops grown on sandy soils deficient in magnesium.

Credit for this achievement goes to the mining and engineering staffs of International Agricultural Corp., which owns a controlling interest in Union Potash. Exploration work was completed late in 1939 and the main shaft sunk to the 850-ft. and 1,000-ft. levels from which the two ores, langbeinite ($K_2SO_4.2MgSO_4$) and sylvite (KCl) are now being mined. Construction on the refinery commenced in June, 1940, and was completed and most of the equipment was in operation within four months —an unusual record under even the most favorable circumstances. The second, or airshaft, was being completed to the 1,000-ft. level at the time of the writer's visit to Carlsbad in mid-December.

The total investment in this plant is approximately $3,000,000.

Unique processes and equipment have been successfully applied in both the mining and refining of these potash ores. Highly mechanized methods, comparable to those used in the most modern coal mines, have been applied to the production of potash ore. Langbeinite, mined from the 850-ft. level, needs only to be crushed in primary and secondary mills, washed to remove sodium chloride, dried in order to be ready for shipment on a guaranteed basis of 40 per cent K_2O and 18.75 per cent MgO. Sylvite ore, after a preliminary crushing, is classified and the granular product separated from sodium chloride by a patented tabling process. The finely ground material is refined mechanically in flotation cells which remove the 80 per cent of sodium chloride which accompanies this ore. The slurry is filtered in vacuum filters and dried in oil-fired rotary dryers.

Sulphate of potash is produced by an interesting process of reacting saturated solutions of muriate and langbeinite whereby the $MgSO_4$ gives up its sulphate to the KCl and leaves the process as a fairly concentrated solution of magnesium chloride. To date this material has been wasted, but a study is being made of its possible utilization as a basis for magnesium metal and various chemical derivatives.

The total K_2O equivalent of all potash salts produced per year as the plant is now equipped is 80,000 tons. During the coming summer additions will be made which will raise the capacity to 100,000 tons K_2O equivalent. According to the recent "Report on the Potash Industry" issued by the U. S. Department of Commerce, the current consumption of potash in this country amounts to about 385,000 tons of K_2O although its potential use in agriculture alone exceeds 600,000 tons. Present consumption of sulphate is approximately 36,000 tons of K_2O.

Illustrated articles describing the mining and refining operations of the Union Potash & Chemical Co. will appear in subsequent issues of *Engineering and Mining Journal* and *Chemical & Metallurgical Engineering*.

How Europe Produces Its Magnesium

ERNEST V. PANNELL, *Metallurgical Engineer, Bristol, England*

Chem. & Met. INTERPRETATION

The present world war is greatly increasing the importance of magnesium metal. Extensive use is being made of it for aircraft castings, and to some extent for rolled and forged material; flares and incendiary explosives account for a large proportion of output. The vast expansion program in production facilities throughout the world has necessarily created active interest in the several electrochemical processes that are in use or have been proposed for its recovery. The author discusses the processes employed by each of the leading European countries. His comments on the new methods in use in his own country are particularly worthwhile.—*Editors.*

War conditions in Europe have accelerated the production of light metals particularly magnesium and it is estimated that this metal is being produced at the rate of 45,000 tons per year. Of this total it is computed that the German works contribute 60 per cent, and the French and Italian plants coming under the control of the Axis, an additional ten per cent. Extensive use is being made of the metal for aircraft castings, and to some extent for rolled and forged material; flares and incendiary explosives account for a great proportion of the output and the balance is used for deoxidation and for aluminum alloy metallurgy. Industrial uses are of course at a standstill. While the foregoing estimates appear to show a one sided position it should be added that Great Britain has become strongly entrenched in the field of magnesium production during the last few years. Further, it is fully equipped with the most modern technique and rapidly extending plants for production by two or three of the most economical processes. There is also in Britain no lack of ores which can be reduced.

As will be seen there are two main methods of producing the metal; first by electrolyzing the chloride and second by electrosmelting the oxide. The natural ores which form the starting point of the process are as follows: magnesite ($MgCO_3$), dolomite ($MgCO_3$—CaO_3 and carnallite ($MgCl_2$—KCl). Other natural ores such as brucite (MgO) and kieserite ($MgSO_4$) have not so far been used for commercial production. It should be added that all these compounds include water of crystallization to a greater or less extent and are not available for reduction until dehydrated.

The distribution of these ores is local; magnesite deposits of high quality are found in Austria and Greece; extensive tonnages have also been blocked out by Japanese engineers in Manchukuo. Carnallite appears to occur in workable deposits only in Stassfurt, Germany, and in the Ural, Russia. Dolomite is widely distributed and is plentiful in Britain. Brines from sea water or inland springs have been little exploited in Europe though a plant in Italy is now starting up based on sea water brine as a source of magnesium. By far the greater proportion of the metal is derived from magnesite or dolomite.

In its history magnesium is closely associated with aluminum having been first isolated by Davy in 1808 and first electrolyzed on a practical working basis from a bath of fused salt in 1896, seven years later than aluminum. Its heat of oxidation is 6,000 cal. per g. as compared with 7,000 for aluminum. The theoretical yield is 0.448 g. per amp.-hr. as compared with 0.335 for aluminum, the nominal voltage of decomposition being 2.2 and 2.8 respectively. Its high position on the electrothermal scale makes it impossible of reduction exothermically by any other element. Experimentally it has been deoxidized by aluminum the reaction being slightly endothermic but commercially uneconomical. Its reduction from the oxide by carbon readily takes place at 2,000 deg. C. but the reaction is reversed on cooling. All fused electrolytes are heavier than magnesium which has a density of 1.75 solid and about 1.55 fused; it is therefore ladled off at the surface of the bath instead of being tapped like aluminum. It volatilizes at 1,120 deg. C. and is recovered in this form in modern electric furnace production. The most outstanding and embarrasing difference from aluminum is that magnesium oxide is practically insoluble in fused salts and long and costly tests have unfortunately proved that decomposition of magnesia in a fused chloride or fluoride bath is not commercially economical. Recovery from aqueous solutions is impracticable by reason of hydrolysis.

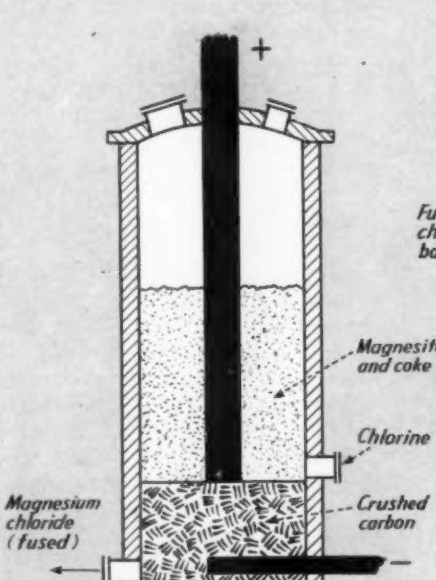
CHLORIDE PROCESS

Fundamentally the electrolysis of magnesium-potassium chloride inaugurated by the Griesheim-Elektron A.G. at Bitterefeld in 1896 has been carried on to the present day although production in Germany is now under the control of the I. G. Farbenindustrie. Native carnallite is still used, also mixed chlorides or straight magnesium chloride. In favor of the mixed bath it may be said that the presence of other chlorides gives greater fluidity and reduces electrical resistance. The chief requirement is that the salts should be anhydrous. Six water molecules are associated normally with magnesium chloride and after crushing the compound can be evaporated down to the dehydrate containing

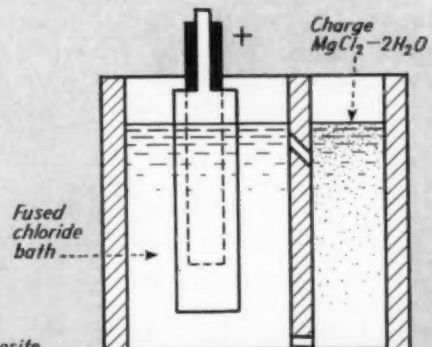
two molecules. Subsequent heating leads to heavy oxidation losses for which reason the final dehydration has been carried out with an admixture of ammonium chloride or in an atmosphere of hydrochloric acid. In both cases the process is a troublesome one on account of the corrosive action of the gas and the high cost of operation. The same objection applies whether carnallite or the end liquors from the potash plant be employed. The indications are that European producers favor a dry method of evolving anhydrous magnesium chloride or of using some expedient to charge the electrolytic cell with the dehydrate.

The first method involves the chlorination of magnesite or magnesia. For this purpose a resistance furnace is used in the form of a tower having a vertical electrode extending down through the roof and another at the base embedded in a bed of crushed carbon. The tower is charged with a mixture of crushed magnesite and coke, chlorine is run in at the base and the carbonate is converted to chloride which is tapped in the fused condition and fed to the electrolytic cells. The temperature is maintained at 700 to 900 deg. C. and the mixed gases escape at the top. The chlorine is derived from the electrolytic bath in the reduction process.

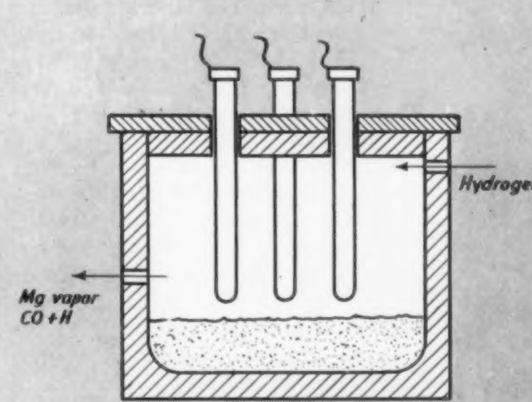
In England a similar operation is followed with the difference that magnesium oxide is chlorinated instead of magnesite, the latter having been previously calcined; this appears to give smoother operation and a better yield. In a modification of the process the tower is fed at the top with magnesia in suspension in fused magnesium chloride. From the reduction pots a current of



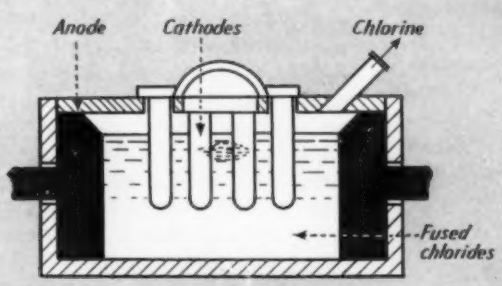
I. G. type of chlorinating tower for magnesite



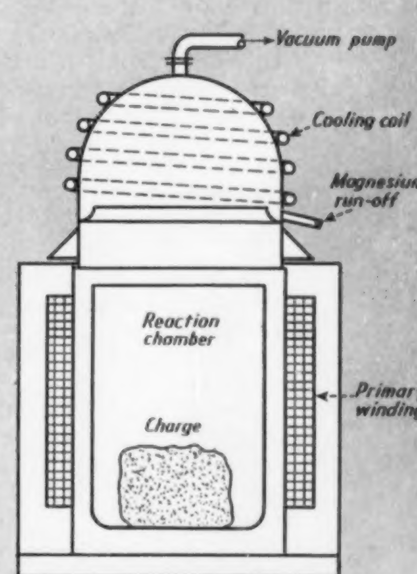
I. G. combined cell for dehydrating and electrolyzing magnesium chloride



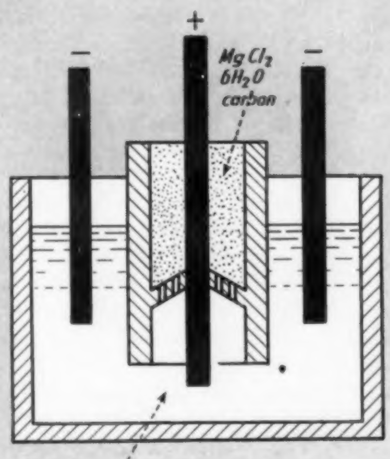
Koehler furnace for magnesium reduction



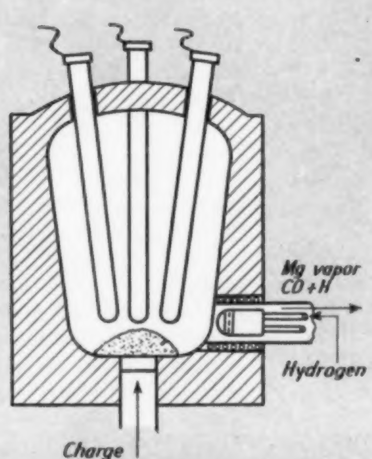
Hulin type circular pot with side anodes and central cathodes



Blackwell-Turner induction furnace for production of magnesium



Suzuki cell for dehydration and electrolysis of magnesium chloride



Radenthein furnace for magnesium reduction

carbon monoxide and chlorine are blown in at the foot. The fused chloride is recirculated producing about its own volume of fresh $MgCl_2$ per cycle.

When dealing with dolomite the mixed carbonates are first calcined and the product leached with magnesium chloride and filtered; the insoluble magnesia is dried and chlorinated in the usual way. Meanwhile the calcium chloride filtrate is treated with ammonium carbonate; ammonium chloride from the exchange reaction is stirred with a portion of the magnesium hydroxide to produce a further charge of magnesium chloride for use in the process. Generally, however, this method is used where magnesium is a byproduct of a potash plant in which case the end liquors or tailings from potash recovery yield the necessary magnesium chloride solution.

Apart from the methods outlined for producing fused anhydrous magnesium chloride, European plants are also following the practice of charging the reduction pots with a partially dehydrated chloride derived from natural carnallite or other source. According to some authorities there is no inconvenience arising from charging the hexahydrate direct provided it is introduced in the anode compartment. This optimistic view is not borne out in practice as the results involve not only a sharp rise in voltage but explosive effects which impair the quiet smooth operation necessary for all electrolytic processes. It is more usual to dehydrate the material to the stage where it carries two water molecules. One German producer mixes crushed coke with dehydrate introducing the mixture into the bath in a perforated fireclay receptacle through which the electrolyte can percolate. The same method is used with magnesia and magnesite which is chlorinated by the anode product.

SUZUKI CELL

The Suzuki cell is a Japanese development which has attracted some attention in Europe; it provides a cylindrical chamber with a perforated false bottom, the chamber surrounding the anode. This compartment is packed with a mixture of magnesium hexahydrate and finely crushed carbon. The heat of the reaction dehydrates the salt in a reducing atmosphere and it is converted to anhydrous chloride replenishing the bath continuously.

The I. G. Farbienindustrie, the largest magnesium producers in Europe, employ an electrolytic cell of rectangular plan divided in two parts. The larger working compartment contains the graphite anode, iron cathode and the usual shallow separating baffle. The smaller antechamber communicates with the main compartment by a slot near the top and another at the base. This chamber is charged with dehydrate which immediately comes into contact with chlorine liberated at the anode and entering through the upper slot; it is dehydrated and fused sinking to the bottom and entering the main compartment on the anode side thus replenishing the electrolyte. As this method is used with a bath of mixed chlorides the charge must be calculated so as to maintain the correct proportions. In other words magnesium chloride should be fed in at the same rate as it is decomposed. In passing it should be mentioned that natural carnallite, frequently used for a mixed chloride bath, often contains a small percentage of sulphate. This is reduced by heating with sawdust in an early stage; if this is not done the oxidizing reaction in the bath will prevent the agglomeration of the nascent magnesium.

POT ROOM PRACTICE

Pot room practice in Europe generally favors the use of units with a refractory lining instead of unlined steel tanks; this conserves heat and in most cases eliminates outside heating. Separate steel or wrought iron cathodes are employed with a baffle to shield the anodes and allow the metal to reach the surface in the cathode compartment. Liquid cathode methods involving use of molten lead or aluminum are now little used.

A circular pot of the Hulin type is employed in France and Russia; it will be seen this reverses the usual location of anode and cathode. The former constitutes a substantial circular wall around the cell while steel cathodes, six or more in number, are mounted in an inner ring current being led in at the top. A central covered opening gives access to the pool of metal which is periodically ladled out.

In most cases however pots are rectangular and of 15,000 to 20,000 amp. capacity. Voltage averages seven to eight, temperature 750 deg. C., and energy consumption 9 kw.-hr. per lb. of metal. Electrolytes are a mixture of magnesium, potassium and sodium chlorides varying between wide limits but usually with a maximum of 70 per cent and a minimum of 10 per cent magnesium chloride. The metal is removed in perforated ladles and transferred to a holding pot using a special flux of mixed chlorides. Furnace residues are dumped outdoors, weathered and recovered as magnesium carbonate which is re-chlorinated.

OXIDE PROCESS

Electrothermal methods only are used for the reduction of magnesia on a commercial scale the metal being vaporized by the heat of the arc and drawn off, condensed and remelted. As already mentioned recombination quickly takes place when the metal cools; the main problem is therefore to maintain a reducing atmosphere throughout. An American investigator, Koehler, developed a process in 1927 which appears to be the prototype of present European practice although there are some differences in detail. Koehler found that in a closed electric furnace an atmosphere of hydrogen or a hydrocarbon gas was apparently effective not only in reducing the oxide but in suppressing the tendency to reoxidize in the presence of carbon monoxide and water vapor. In the Radenthein process now being employed in England and in Austria, a three phase furnace is continually charged at its foot with a finely ground mixture of magnesia and carbon. Under reduced pressure and in the heat of the arc the metal is reduced and vaporized. It is exhausted, together with furnace gases through a side aperture surrounded by a cooling coil. A water-cooled tuyere is located in the center and through it.

Hydrogen is blown and the metal vapor and gases consisting of hydrogen and carbon monoxide are drawn off together. After passing through a filter or dust precipitator, the mist or vapor is condensed in a solid form on water cooled tubes at 200 deg. C. whence the sublimate can be collected. A percentage of the metal naturally condences on the passages and in the filter; the collection of this material is essential to the economical working of the process. All the solid product is now diluted with its own bulk of distillation residues and briquetted for the second distillation. The dilution products form a sponge-like structure from which the magnesium can be vaporized more easily than from a homogeneous block. This distillation takes place at 800 deg. C. still under reduced pressure and in a hydrogen atmosphere and is drawn through condensers. These latter

consist of steel towers each having an oil-cooled tube descending from the top and a reservoir of mineral oil at the base. Magnesium condenses in liquid form on the tubes dripping into the oil in granules. By use of a lock, the metal can be withdrawn at the bottom without breaking the vacuum; the continuity of the process is thus maintained. Subsequent operations are centrifuging and remelting to remove the oil after which the metal is cast into ingots for commerce.

Variations exist in the foregoing procedure; for example a spray of hydrocarbon oil is interpolated which by contact with the metallic vapor reduces the possibility of oxidation. Again provision is sometimes made for the introduction of hydrogen in different parts of the system to maintain the reducing atmosphere necessary. It will be seen that the characteristics of the process involving an explosive reaction, carefully controlled temperatures and vacuums and the apparent absence of regenerative features form a striking contrast to the relative quiet of the electrolytic process with its wider temperature range and simpler control. The Radenthein process is however amenable to a greater extent to mechanization.

RELATIVE ECONOMY

As regards relative economy, costs of electrolytic production are, of course, dependent on the nature and quantity of the byproducts which in some instances have alone made the reduction of magnesium commercially possible. Comparisons are therefore not easily made with the electrothermal method which stands squarely on the manufacture of metallic magnesium alone. It is reported that the Radenthein process consumes 11 kw.-hr. per lb. of metal as compared with the chloride process which requires 9 kw.-hr. The chief problem in the economical running of the former is the avoidance of waste by loss of vapor and oxidation. In respect of purity the distillation product naturally ranks high giving a final metal percentage of 99.97 per cent as compared with 99.90 for the electrolytic method. The nature of the impurities rather than their proportion has been the chief drawback to the chloride process as the small percentage of salts present in the metal seriously reduce corrosion resistance.

A new and promising method of recovery is being used by a British producer and is based on the use of a high-frequency induction furnace and a solid reducing agent such as ferro-silicon or calcium carbide. A wide variety of materials may be employed in the process provided they have a reducing action and leave a solid residue. The reducing agent is ground and intimately mixed in a compact mass with the magnesia and charged into the central chamber. The furnace is closed and evacuated while current at from 10,000 to 50,000 cycles per second is switched on to the primary winding. Eddy currents are set up in the charge which is heated to the vaporizing point of magnesium. The vapor rises and is condensed on the inner surface of the covering dome or cupola the latter being surrounded by a cooling coil. In most cases an iron rod or pipe is inserted in the center of the reacting charge to form a core; this by its magnetic permeance assists the inductive effect and eccelerates the heating. In cases where a non-conducting material is used e.g. calcium carbide the charge is placed in a graphite crucible which itself forms the secondary for the transformer action.

The process is necessarily intermittent: when the reaction is complete the cooling coil and electric circuits are cut off and the cupola is heated by an electric winding. This liquifies the condensed magnesium which runs down into a channel and out through a tapping hole whence it can be remelted and cast into commercial forms. This process (patented by Blackwell and Turner) is the simplest and apparently the most foolproof yet devised for the recovery of magnesium. It is free from most of the difficulties attaching to other methods such as violent explosive reactions, gas leakage and loss and contamination of vapor and sublimate. The method appears to mark the most advanced step in the commercial production of magnesium.

MAGNESIUM CHLORIDE

PRODUCTION of anhydrous magnesium chloride was discussed by L. M. Pidgeon and N. W. F. Phillips of the National Research Laboratories, Ottawa, Canada, before a recent meeting of the Electrochemical Society. The authors have made a study of direct chlorination of magnesium oxide in the presence of carbon, producing the anhydrous chloride suitable for the fused electrolyte process.

Their conclusions were:

1. Anhydrous magnesium chloride can be produced by passing chlorine through a mixture of magnesium oxide or sulphate as a binding agent, tween 800 deg. and 1,000 deg. C. Reaction at temperatures below the melting point of magnesium chloride is not feasible commercially.

2. The solid charge must be introduced into the reaction chamber in porous form in order that chlorine may have complete access. This is accomplished either by briquetting the powdered material or by introducing the magnesium oxide as mechanically resistant particles.

3. By employing magnesium chloride or sulphate as a binding agent, mixtures of powdered magnesium oxide and carbon may be briquetted into a form suitable for magnesium chloride production.

4. To prevent excessive chlorine losses it is necessary that the briquettes be heated to 500 deg. C. to remove combined water. This action, however, causes considerable loss of chlorine from briquettes bound with magnesium chloride.

5. Above the melting point of anhydrous magnesium chloride (708 deg. C.) increase in porosity of the briquette decreases the total amount of magnesium chloride per unit volume but increases the percentage conversion. Below the melting point of magnesium chloride the percentage conversion is the same after the lapse of sufficient time.

6. Without the use of special devices, briquettes will not chlorinate further than 50 percent either above or below the melting point of magnesium chloride. To complete the reaction this partially converted material must be heated to form a fluid paste which is caused to flow down through a heated mass of granular carbon with a stream of chlorine flowing counter-current.

7. Magnesium chloride may be produced by chlorinating directly granular mixtures of magnesium oxide and carbon at temperatures above the melting point of magnesium chloride. If granular material is available, the necessity of briquetting is obviated and chlorine losses occasioned during the drying eliminated.

8. An increase in the density of the magnesium oxide granules causes a decrease in the rate of chlorination.

9. In contrast with briquettes, no special means are needed to carry the reaction to completion above the melting point of anhydrous magnesium chloride. After a layer of magnesium chloride sufficient to wet the granule builds up, oxide-free product runs off.

Thermal Insulation for Industry

S. V. SAGINOR *Production Manager, Davey Compressor Co., Kent, Ohio*

Chem. & Met. INTERPRETATION

Increasing complexity of the problem of thermal insulation, both in industrial requirements and in the materials available, demands frequent review of this important subject. The author is an engineer who has devoted more than 12 years to the specification and design, as well as the supervision of installation of insulations, for one of the largest chemical plants in the United States. In that connection he encountered a diversity of problems in the entire temperature range which particularly fit him to discuss the proper approach and to assay the materials now available. —*Editors.*

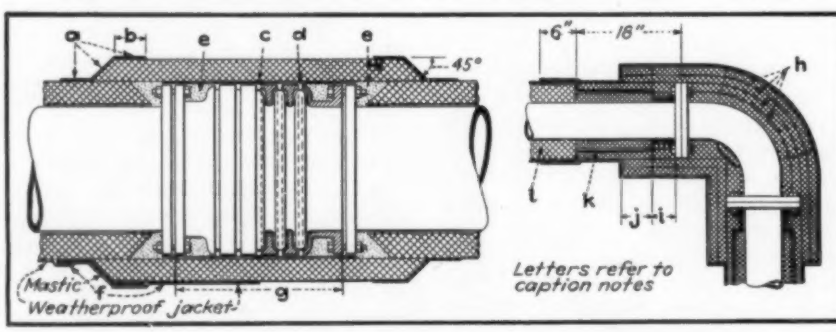
FROM NUMEROUS STANDPOINTS the problem of suitable thermal insulation is more complex today than it has been in the past. Not only has the variety of thermal insulants increased quite rapidly, but the demands put upon these materials have become increasingly more difficult of fulfillment. Economy in operation, ease of control, and the safety and comfort of operating personnel are factors that are now to a greater and greater extent dependent on the efficient retention of heat or cold in processing lines and equipment.

Starting only a century ago with Peclet's experiments to determine the conductivity of metals, the first commercial insulation, developed in the early 70's consisted of insulation in the form of plastic cements manufactured from clay and asbestos fiber which were used on pipe and boiler surfaces. From this attempt at an all purpose material careful development has given us individual materials suitable for various ranges of temperature and conditions of service. The late 70's first saw corrugated asbestos paper wrapped to form the air-cell type of insulation suitable for temperatures under 300 deg. F. In 1885, 85 percent magnesia was developed. This material suitable for temperatures up to 600 deg. F., consists of 85 percent of magnesium carbonate mixed with 15 percent of asbestos fiber, a composition of good insulating efficiency as well as considerable mechanical strength.

Laminated asbestos insulation made by cementing together layers of asbestos felts with narrow bands of sodium silicate was the next important development. This insulant, with a limiting temperature of 700 deg. F., and suitable for conditions of abuse or excessive vibration, was further improved by indenting the felts and imbedding particles of sponge in the felts during manufacture. In 1905 argillaceous limestone, heated and blown into fibrous form, was offered as an insulant for temperatures up to 1,200 deg. F. This was the beginning of the mineral wool line of insulants which today includes slag wools, rock wools and glass wools. Then there was developed by 1925 a series of products employing diatomaceous silica as a base. These products, suitable for temperatures from 600 to 2,500 deg. F., use diatomaceous silica in the natural state or mixed with asbestos fiber for the lower range, and calcined or burned with clay for the higher temperatures.

Exfoliated mica or vermiculite (aluminum magnesium silicate) was introduced in the last few years for temperatures up to 1,600 deg. F. In the same range, bauxite monohydrate insulations are also produced by chemical treatment of raw bauxite. The finished product includes the addition of asbestos fibers and compounds of silica, magnesia, calcium, and alumina. Aluminum foil and other highly polished metals effective to 1,200 deg. F. are also used today in various fabrications, their value depending on their high reflective ability and light weight. An insulant is now being developed

Suggested method of insulating expansion joint and elbow for cold service



Notes: (*a*) Tape to be applied with a two-thirds lap in order to obtain three layers over flare and 6 in. on either side thereof. Double coat of sealing compound to be applied on outside of tape only.

(*b*) This distance to be twice the thickness of insulation.

(*c*) Sheet metal jacket secured at center only with ½ x 0.015 in. galv. steel strap.

(*d*) No. 26 ga. galv. sheet metal jacket side lap to be secured with sheet metal screws 6 in. center to center. To include expansion joint and flanges only.

(*e*) Fill space between end corrugation and flange with insulation.

(*f*) Where weatherproofing is required, apply mastic and weatherproof jacket as indicated.

(*g*) No insulation between sheet metal jacket and expansion joint.

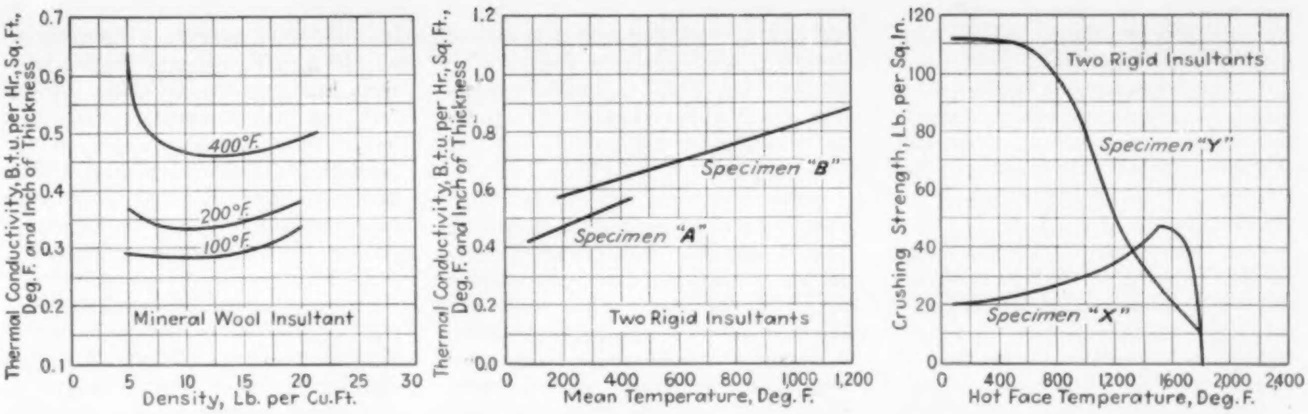
(*h*) Blanket insulation secured in place with jute twine.

(*i*) Sufficient for bolt removal, but not less than 3 in.

(*j*) Not less than thickness of insulation nor less than 2 in.

(*k*) One layer of tape and one coat of sealing compound for inner seal.

(*l*) Sectional insulation secured in place with galv. iron wire or galv. steel strap as specified.



Change in properties of insulant test specimens of kinds noted: Left, thermal conductivity vs. applied density; center, thermal conductivity vs. mean temperature; right, crushing strength variation for various hot face temperatures

from waste pickle liquor from steel mills, and processed water glass or silica aerogel, one of the newer developments, also offers promise with its apparent ability to withstand 1,500 deg. F. without breakdown.

Development of low temperature insulation for refrigeration purposes started in 1890, with the commercial production of vegetable cork board and sectional pipe insulation, the natural gums brought out by heat treatment serving as the bonding agent. Cattle hair has been used for many years and is still used extensively for this purpose, requiring, however, extreme care in application. Tremendous improvements and refinements have been made in the mineral wool industry and today this material, when properly processed and treated with special oils for the flexible forms, or with asphalt to produce block and sectional forms, is highly effective for use at the lowest industrial temperatures.

Fibrated wood also forms the base for some products designed to be used primarily in the low temperature field. A fairly recent material introduced for low temperature use is sponge or expanded rubber. At extremely low temperatures this latter material has some disadvantages which preclude extensive use at present.

There are many types of so-called insulating cements on the market but each has a specific purpose for which it is best suited. The asbestos cements find application as insulation for small fittings and as a finish for the primary insulant. Magnesia, vermiculite, diatomaceous silica or mineral wool cements are used as primary insulants on irregular surfaces where blanket, sheet or block insulation are not adaptable. These cements do not finish smooth and require the use of portland cement in the last coat, or a finishing coat of properly reinforced asbestos cement, for good appearance.

The tremendous investment today in thermal insulation for industrial processing, power plants and the like, makes it imperative that design requirements be carefully considered. Since there may be nothing in the appearance of an insulant in service to indicate progressive failure until complete failure occurs, it is essential that performance be determined as nearly as possible before purchase and installation.

INSULANT REQUIREMENTS

A good insulant is generally constructed on the basic principle of numerous air cells which prevent the flow of heat. Highly polished light colored metals, however, such as aluminum foil, although inherently not insulants, serve to retard the flow of heat by functioning as reflectors. Since the original efficiency of commercial insulants depends primarily on the voids they contain, these voids should preferably be microscopically small so that circulation within them and radiation across them will be reduced to a minimum.

The material must further be adaptable to the condition for which it is being considered, that is the insulant must be of such form as to be easily applied. It must have high original resistance to heat flow and the ability to retain this resistance; it must have sufficient strength for proper handling and application. Ability to withstand wear and tear encountered in service is also important. In some cases it should be vermin-proof, not susceptible to bacterial growth and, in itself, odorless. It must have the ability to withstand the temperatures to which it will be subject without appreciable deterioration. To be effective at low (refrigeration) temperatures the insulant should be, in itself, highly resistant to moisture vapor penetration or be properly protected by an asphalt coating, asphalt impregnated membrane or other suitable vapor barrier. It is well known that the original efficiency may be greatly reduced within a short period of time due to moisture absorption. As a consequence, at low temperatures, the insulant may fail to give anticipated protection on account of moisture vapor migration for a considerable time before actual complete failure occurs, resulting of course, in uneconomic operation and the ultimate necessity of renewal. Although no insulant can in itself be considered absolutely vapor-proof, great strides have been made in the asphalt or oil impregnation of mineral wools so as to make some of them excellent for low temperatures, such as are encountered in the industrial field, without extensive supplementary sealing. Insulating for low temperatures, below 32 deg. F., demands even more extensive knowledge of insulants than for high-temperatures. Definite data on thermal and atmospheric conditions are essential for proper design. Careful training and experience for effective application are also required.

The economic thickness of an insulant is determined primarily by the fuel (or power) saving and the actual dollar value of this conserved energy. This, of course, means the original cost of the fuel saved, plus the additional materials and labor required for the utilization of this fuel to produce heat (or refrigeration) for the operation involved. It is evident, therefore, that the economic thickness or limit is determined by the additional fuel or power saved by each consecutive layer or

thickness of the insulant involved. Since a proper analysis of the economic value of insulation on a specified piece of piping or equipment is based on actual operating hours at the design temperature, a careful check should be made to see whether operation is intermittent and, if so, to what extent.

With safety constantly assuming greater importance in industrial operation, it is generally advisable to insulate all exposed hot piping or equipment regardless of whether or not the value of the heat saved justifies such an expenditure. Particularly in connection with hot lines to instrument panels, steam condensate lines or waste gas flues venting to the atmosphere, in which cases the heat saved may have no economic value, a minimum of insulation should be applied to prevent scalding. Measured in terms of human safety and comfort, protection against scalding has a definite dollar value of its own which justifies insulating hot surfaces to bring the exposed area down to no more than 180 deg. F.

Heat loss from exposed hot surfaces, say from equipment operating at 400 deg. F., would soon tend to bring the ambient air temperature up to a point where human operation in that area would be impossible. This of course is an extreme case but it is mentioned to emphasize that here again although the heat, say from a chemical reaction, might not have a direct economic value, there is a dollar value in human comfort as is indicated by the tendency of operators to slow up in production and become decreasingly alert when operating under uncomfortable conditions. It can generally be assumed that a surface temperature of 140 deg. F. will not permit sufficient heat transfer to cause discomfort and consequently, since this temperature is also well below the "scalding" point and generally close to the economic limit, it is desirable to supply sufficient insulation to approach this surface temperature if possible.

Particularly in the chemical industry, and in other industries where low flash point solvents or other chemicals having low auto-ignition points are used, it is necessary that a careful check be made to avoid hot surfaces dangerous from this angle. Particular care must be taken in such areas to cover all flanges, brackets, legs, or other projections from hot equipment to avoid flashing to nearby processes. The properties of flam-

Some Physical and Thermal Characteristics of Commercial Insulants

Material	Commercial Forms Available	Upper Limiting Temp., Deg. F.	Density, Lb. per Cu. Ft.	Thermal Conductivity, B.t.u. per Hr., Sq. Ft., Deg. F. and In. Thickness at Mean Temperature, Deg. F.											
				100	200	300	400	500	600	800	1,000	1,200	1,500	2,000	2,500
Aluminum Foil	Built-up sectional and block	1,000	0.2	0.28	0.37	0.39	0.46	0.52	0.58						
Asbestos	Loose fiber	800	36	0.16	1.23	1.40	1.45	1.48	1.50	1.56					
Asbestos Finishing Cements	Loose dry	1,000	48–60		1.50										
Asbestos Air Cell	Sectional and block														
	4 plies per inch	300	12	0.53	0.65	0.77	0.89								
	8 plies per inch	300	19	0.48	0.56	0.63	0.71								
Asbestos Felts (sponge felt)	Sectional and block														
	40 laminations per inch	700	30	0.40	0.44	0.49	0.53	0.59							
	20 laminations per inch	700	20	0.55	0.61	0.67	0.73	0.79							
Asbestos Millboard	Sheets	1,000	54	0.90	0.95	1.00	1.20	1.40	1.50						
Asbestos Sprayed	Loose fiber and liquid binder	800	7	0.36	0.41	0.46	0.53	0.63							
Concrete — Insulating Type	Loose granular	1,800	31	1.72	1.80	1.87	1.94	2.01	2.08	2.23	2.37	2.51	2.73	3.43	
Concrete — Insulation Refr'y	Powder	2,200	65			2.78	2.82	2.86	2.90	2.98	3.09	3.20	[illegible].44	3.84	
Cork	Sectional and block	200	11	0.30											
Diatomaceous Earth	Fine powder	1,600	15–17	0.38	0.41	0.44	0.48	0.51	0.55	0.62	0.69	0.76	0.86		
	Coarse powder	1,600	22	0.45	0.48	0.52	0.55	0.59	0.62	0.70	0.77	0.84	0.95		
High Temp. Alumina and Diatomac. Silica Mixtures	Sectional and block	1,900–2,000	24–30		0.59	0.61	0.64	0.68	0.70	0.76	0.82	0.88			
Hair Felt	Blanket	200	13	0.30											
Silica Brick	Brick	3,100–3,300	130–150	6.20	6.50	6.80	7.00	7.30	7.60	8.20	8.80	9.40	10.20	11.70	13.20
Firebrick	Brick	2,250–3,200	110–112	5.80	6.00	6.20	6.50	6.70	6.90	7.40	7.80	8.30	9.00	10.20	11.30
Red Brick	Brick	500–1,000	100–120	4.50	4.70	5.00	5.20	5.50	5.80	6.30	6.80	7.30	8.10		
Insulating Brick	Brick	2,500	39–53		1.57	1.73	1.84	2.01	2.14	2.50	2.53	2.83			
Insulating Brick	Brick	2,000	28–38		1.12	1.15	1.19	1.23	1.27	1.37	1.48	1.62			
Insulating Brick	Brick	1,600	30		0.78	0.81	0.85	0.89	0.93	1.00	1.09	1.16			
Kapok	Blanket	212	1	0.25											
Magnesia — 85%	Sectional and block	600	17	0.43	0.47	0.51	0.55								
Magnesia Cements	Loose dry	600	21	0.48	0.54	0.60	0.66								
*Mineral Wools (untreated)															
Glass Wool	Loose, flexible		3	0.26	0.32	0.41	0.61								
	Sectional and blanket	1,000	4	0.24	0.30	0.38	0.52								
			8	0.22	0.26	0.30	0.36								
Rock Wool	Loose, flexible		5	0.29	0.37	0.47	0.64								
	Sectional and blanket	1,000	10	0.28	0.33	0.39	0.46								
			15	0.29	0.35	0.40	0.47								
			20	0.34	0.38	0.43	0.49								
Slag Wool	Loose, flexible														
	Sectional and blanket	1,000	Generally same as Rock Wool												
Mineral Wool Type Cements	Loose dry	1,500	24–30	0.57	0.61	0.66	0.77	0.88	1.02	1.15	1.44				
Mineral Wool (waterproofed low temperature type)	Board	225	18	0.36											
	Sectional and block	165	15	0.30											
	Blanket	225	16	0.29											
Vermiculite	Loose, sectional and block	1,600	17	0.57	0.64	0.69	0.73	0.76	0.80	0.89	0.98				
Vermiculite Type Cements	Loose dry	1,800	16	0.74	0.79	0.84	0.89	0.94	1.04	1.14	1.25				
Wool Felt	Sectional or block	212	24	0.36											

Note: Conductivity figures represent average value of commercial makes of various manufacture. Conductivity of cements, loose fills and flexible insulants varies with applied density.

*Some manufacturers recommend 1,200 deg. F. limit for mineral wools.

mable liquids, gases, and solids should be carefully checked for the auto-ignition point when there is any question as to the safe surface temperature limit.

There are many cases in industrial practice when the importance of control of a process temperature takes precedence over the other benefits derived by the use of insulation. For instance it is not uncommon in the chemical industry to be asked to prevent a drop of more than 10 deg. F. in the temperature of a piece of equipment. Perhaps a fluid in a pipe line would freeze at 4 or 5 deg. below the average ambient temperature. Or, a liquid ammonia tank exposed to the sun's rays would require insulation to prevent excessive evaporation of the liquid stored, with subsequent venting of ammonia gas to the atmosphere. The general case, however, is the desire to maintain heat losses as near a minimum as possible and the desired limit is the determining factor in determining the thickness of the insulant to be used.

An interesting industrial development of thermal insulation is its application to the fireproofing of steel work. In tests made by the Institute of Fuel, it was found that an uninsulated girder collapsed within 15 minutes when exposed to a flame temperature of 1,500 deg. F., whereas the temperature of an insulated girder did not exceed 200 deg. F. after 75 minutes.

Heat is usually generated for power, and the equipment or process is dependent on receiving the proper amount of heat or heat-carrying fluid for anticipated operation. Consequently, in addition to the other factors involved, it is essential that lines and equipment be insulated against heat transfer so that desired operating capacity can be secured at an economic cost. It is obvious, for instance, that an uninsulated boiler would have to generate at a higher capacity than an insulated piece of equipment to get equivalent heat delivery. In many instances this results in longer life for the insulated equipment.

Normal depreciation or obsolescence of piping or equipment must also be carefully considered in determining the economic value of insulation based on the estimated life of piping or equipment. These factors, however, are again contingent on the operation involved, the type of equipment, its location, etc. For instance, 15 years can generally be considered the normal life of power plant piping and equipment, while equipment and piping involved in processing may not have greater than a 3-year life before depreciation or obsolescence wipes out the original investment. In this connection there may frequently be replacement of gaskets resulting in consequent removal and possible replacement of a portion of the insulation, and in this latter connection it may be economical to design a portion of the insulation to facilitate easy removal and replacement.

It is also highly important to determine if possible the amount of abuse to which the insulant will be subjected. If piping or equipment will be subject to considerable vibration, moisture exposure or other abuse, an insulant must be selected that will withstand these conditions.

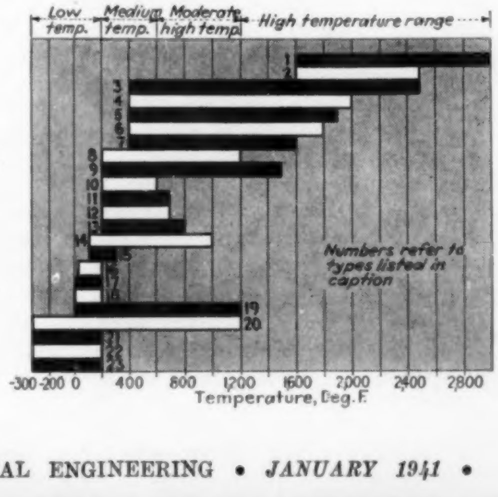
It is imperative that the designing engineer check for clearances required for the application of the proper type and thickness of insulation. The cost of an installation can be increased considerably, particularly in low temperature work, when there is insufficient clearance for the proper installing.

In making an analysis of the proper type and thickness of insulation for industrial requirements, the author has found the following basic data generally necessary:

1. For what main purpose or purposes is insulation to be provided?
   Medium and High Temperature
   (a) To conserve fuel
   (b) To protect operators against burning or discomfort
   (c) To eliminate fire hazard (if close to a flammable structure)
   (d) To eliminate possibility of flashing in nearby processes
   (e) To maintain close control of temperature in process (If prime purpose is to maintain very close control of temperature in process, the permissible B.t.u. loss per hour)
   (f) To secure maximum capacity of equipment
   Low Temperature Piping and Equipment
   (a) To lower refrigeration load
   (b) To prevent dripping
   (c) To eliminate "sun effect" (if equipment is outside and close temperature control is required)
   (d) To maintain close control of temperature in process
   (e) To secure maximum capacity of equipment
2. Temperature
   (a) Operating temperature
   (b) Maximum and minimum temperatures
   (c) How often is equipment to be brought up to maximum or down to minimum temperature?
   (d) For what periods of time are maximum and minimum temperatures held?
   (e) Is temperature same throughout equipment?
   (f) Is operation intermittent? To what extent?
3. Atmospheric conditions in area considered
   (a) Psychrometric analysis
   (b) Maximum periods of high humidity and high dry bulb
   (c) Maximum periods of low atmospheric temperature
   (d) Corrosive elements
4. Value of heat or refrigeration
5. Estimated life of equipment or piping
6. How often will process require removal of all or part of insulation?
7. Will equipment or piping be subjected to vibration or rough handling?
8. Is there any possibility of chemical overflow and to what extent?
9. Will equipment or piping be exposed to the weather?
10. If equipment or piping is located inside, will installation be made in area subjected to high humidity condition either normal or artificially maintained?
11. What clearance will be allowed for insulation?
12. What clearance will be allowed for application of insulant?

In the final selection of the insulant, after operating and economic factors have been given due con-

Approximate range of some commercial insulants



Key: 1, Silicas and clays; 2, Calcined diatomaceous silica and clays; 3, Bauxite compositions; 4, Calcined diatomaceous silica; 5, Diatomaceous silica and asbestos fiber; 6, Calcined diatomaceous silica concrete; 7, Diatomaceous silica (natural); 8, Vermiculite; 9, Silica aerogel; 10, 85 percent magnesia; 11, Bonded asbestos; 12, Felted asbestos; 13, Asbestos fiber; 14, Asbestos millboard; 15, Commercial asbestos paper; 16, Wool felt; 17, Sponge rubber; 18, Wood fiber and pulp; 19, Aluminum foil; 20, Mineral wool; 21, Cork; 22, Kapok; 23, Cattle hair.

sideration, individual characteristics of the various materials should be considered. It should be recognized however, that constant progress is being made in this field and as new materials are developed a careful analysis of their characteristics should be made. In addition to price, sizes, thicknesses and packages available, additional data are necessary for proper comparison and the author has found the following tabulation of some assistance in securing these data.

1. Kind of service recommended by manufacturer
2. Approximate composition
3. Chemical reaction on metal surfaces (steel, aluminum, copper and alloys)
4. Variation in efficiency and shape over period of time at maximum and minimum constant temperature
5. Susceptibility to decomposition or deterioration from moisture, fumes or at maximum or minimum temperatures for which material is recommended
6. Effect of rapid temperature changes
7. Conductivity curve at mean temperatures through recommended temperature range
8. Specific heat
9. Transverse strength
10. Compressive strength
11. Abrasion loss per "Navy Test Method"
12. Density (as received and as installed)
13. Compressibility
14. Resistance to vibration
15. Shrinkage, per cent of volume
16. Effect of rapid temperature change
17. Fire resistance
18. Waterproofness (inherent resistance to beating rain)
19. Permeability (resistance to infiltration of moisture and moisture vapor migration if used for low temperature work)
20. Recommended method of installation
21. Adaptability to weatherproofing and cement finishes
22. Salvage value

If Insulant is Cement Type

23. Covering capacity, wet and dry
24. Shrinkage by platen test
25. Adhesiveness (resistance to pull)
26. Water mix for best application
27. Will insulant loosen with rapid temperature change?

Flammability of insulants and finishes should be determined, particularly where used in high fire hazard zones, as certain processes present the possibility of auto-ignition where leakage occurs. In these cases asphalt drip from weatherproofing could soon carry a fire throughout the plant. The ignition point of canvas and other wrappings should also be known owing to the possibility of auto-ignition by the escape of heat through end or longitudinal joints of insulation, indicating here the necessity in many cases for broken joints or double layers.

STRUCTURAL STRENGTH

It is also of the utmost importance that we be familiar with the structural strength of insulants at the maximum temperatures recommended, so that selection may be made when required without any hesitancy as to the material's physical ability to withstand field conditions at high temperatures. An insulant may actually show higher insulating values at high temperatures but with such a complete loss of structural strength that slight vibration or abrasion may cause it to disintegrate rapidly. Or the heat loss curve may rise so rapidly at high temperatures as to result in uneconomical installations. In choosing between two or more insulants, structural strength may be the deciding factor. In other designs, other characteristics may determine which insulant to use.

The importance of applied thickness and weight of insulants also justifies proper investigation. The variation in load factor on account of changes in the insulant under service conditions with moisture absorption, dehydration, or possible deterioration is also important, while the variation in conductivity and weight with different applied densities of flexible insulants may considerably affect the design.

Chemical reaction of insulants on various metals should be determined. Plant atmospheric conditions should be taken into account and exposure of the insulant to other possible abuse (such as might result from weatherproofing failure) should be considered when checking possibility of corrosive action.

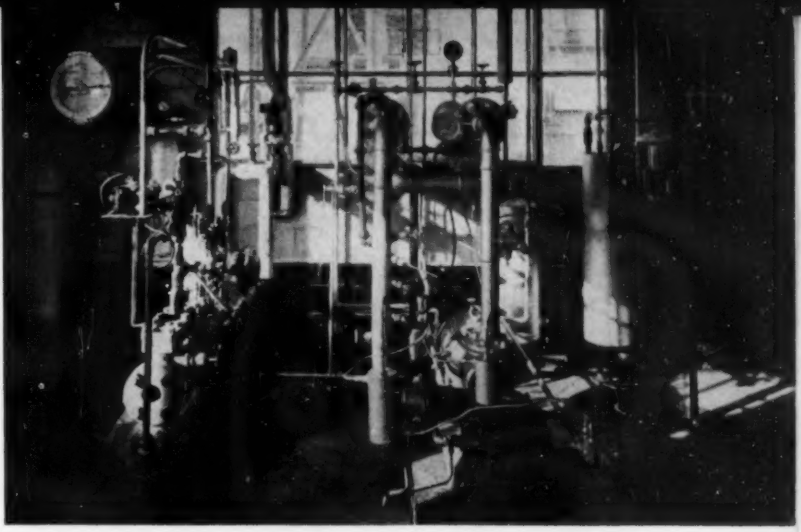
There has been considerable discussion as to the settling of certain insulants and this is one of the distinct disadvantages of some fibrous and granular materials. Manufacturers of these materials have in some instances gone to denser fabrication, or the inclusion of binders, and some real progress has been made along this line. Supports have also been inserted in one flexible sectional insulant merely to carry the load of its own weight.

Certain insulating cements recently introduced to the market have shown interesting properties from the viewpoint of high coverage according to the manufacturer's data, but possible cracking from shrinkage, the relative adhesiveness of the material, and its variation in insulating efficiency over a period of time at the temperature range recommended, must be considered. With sufficient data as to the true characteristics of a cement, use may be found in many cases for materials otherwise arbitrarily rejected. Determination of the requirement for wire reinforcing (adhesiveness) is very important, as the necessity for reinforcing increases the applied cost. Furthermore, the installation on aluminum surfaces of some insulants with galvanized wire reinforcing is undesirable owing to possible electrolytic action. The designer must further take into account the "drying-out" time, as cement insulation should seldom be applied in greater than 1-in. thickness, each inch being permitted to dry out thoroughly before application of succeeding layers. In industrial work, therefore, this required drying-out time may necessitate ruling out the use of cement insulants where completion of the job within a limited period is required.

As to weatherproofing, standard practice calls for protective covering over insulation since the average insulant is not designed to withstand direct exposure to the weather. The incorporation of this additional characteristic in the insulant has, up to the present time, meant a sacrifice in original insulating efficiency. Consequently, where surfaces are suitable for jacket application, heavy asphalt-saturated asbestos or rag felt jackets appear to be satisfactory. On surfaces not suitable for this type of protection (such as ends, tops and bottoms of equipment, fittings and other irregular surfaces) some plastic asphalt types of weatherproofing have proved suitable. In this connection a proper protective mastic should give a cold, odorless and safe application. The elimination of fire hazard through heating asphalts or the use of volatile solvents led to the investigation and use of emulsified asphalt mastics. Such a material, if used, should provide a protective bond, even to wet or damp surfaces, and provide a weather-resisting and protective film that will not check, alligator or dust away on exposure to the weather, retaining its life, elasticity and protective properties for the life of the insulant.

In closing, we might point out the potential need for considering the electrical resistivity of thermal insulants. With our enormous new hydro-electric projects and consequent cheaper electric power, many additional processes may follow the trend to induction heating, requiring special insulation applications.

Economic Aspects Of SYNTHETIC GLYCERINE PRODUCTION



Hydrolysis units for organic chlorides made as intermediates and byproducts in the synthesis of glycerine from propylene

E. C. WILLIAMS and ASSOCIATES *Research Laboratories, Shell Development Co., Emeryville, Calif.*

Chem. & Met. INTERPRETATION

Last month Dr. Williams took *Chem. & Met.* readers behind the scenes and told them how the chemical engineers at the Shell Development Co. produced synthetic glycerine from petroleum hydrocarbons in a pilot plant at Emeryville, Calif. This month he evaluates the all-important economic factors that determine when and why the process should be operated.—*Editors.*

WHETHER THE TIME is opportune for commercial production of glycerine by synthetic methods is a question which may be debated from many points of view. The wide and rather erratic fluctuation in the market price of glycerine during the last 20 years might suggest to the purely rational analyst that there was something seriously wrong with the relation between supply and demand. But closer study leads to the conclusion that there is much of the irrational about these movements; even that they may have been in part due rather to arbitrary decisions than to the existence of overriding economic factors on the one hand or to any far sighted development policy on the other.

Basically, the logical opportunity for a synthetic glycerine process should lie in the growth of uses for glycerine beyond the power of existing sources to supply, or on the desirability of having an alternative source as an influence in smoothing out such wide variations in production and price.

The average selling price for C.P. glycerine over the years 1920–1940 as quoted in the trade press is about 16c. per lb. During this period there have been three peaks; at 28c. in 1920, at 32c. during 1926 and 1927 and at 29c. during 1937. The lowest trough was reached, following a gradual decline through the post 1929 depression years, at a price of 10c. during 1933. Undoubtedly glycerine was sold privately at somewhat lower prices but for the purpose of our comparison these publicly acknowledged figures will serve best.

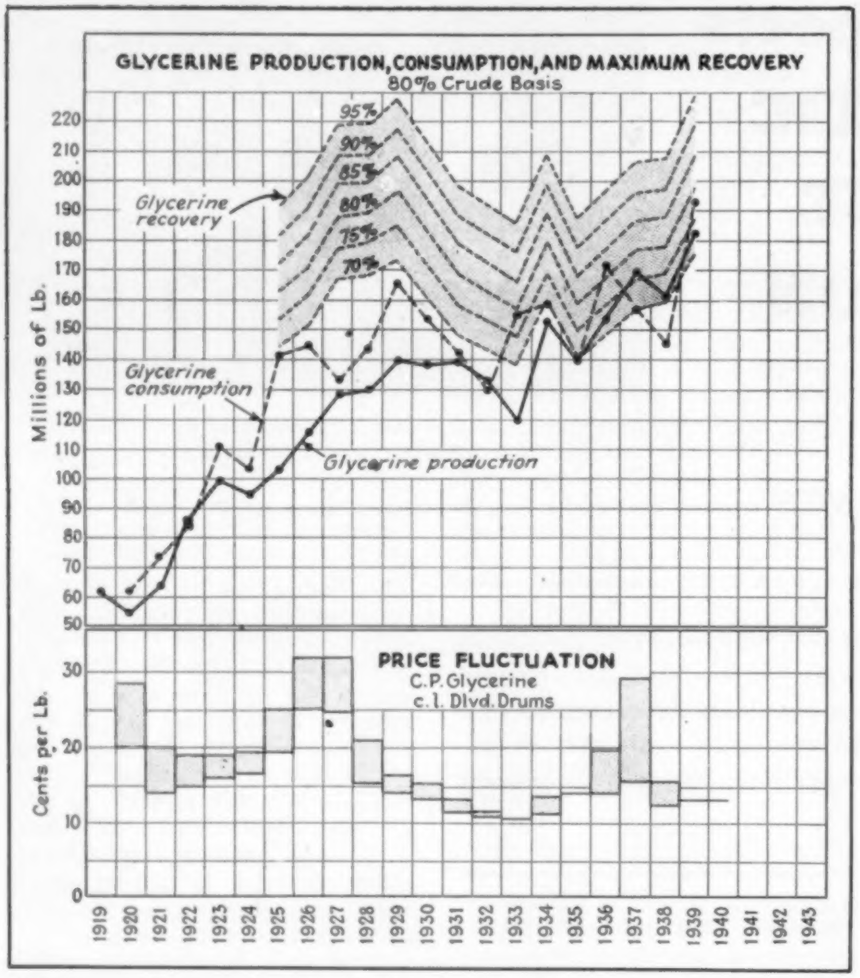
It was during 1936, when prices were rising rapidly towards the peak eventually reached in the following year, that we became interested in the possibility of synthesis from petroleum. We fully recognized, of course, that if glycerine ran according to form we might expect prices to fall again after the rapidly developing peak of that time had passed. Nevertheless, however erratic these movements might have been in the past it was necessary to examine the solid facts which lay beneath them in the belief that they would throw light upon the future.

We have analyzed as impartially as possible the past and present situation with regard to production and consumption of glycerine in the United States. As a basis for our figures we used the published returns of the United States Bureau of Census. Considering the comparatively small number of substantial glycerine producers, and their responsible standing in the country, these figures may be taken as reasonably reliable. Perhaps they may be subject to some minor doubt in times of pronounced speculative activity when brokers not normally in the glycerine business buy, sell, or hold stocks temporarily without making census returns. All figures quoted below are converted to a basis of 80 per cent glycerine.

Production—From 1920 to 1939 inclusive, domestic glycerine production has advanced from 62,000,000 lb. to 184,000,000 lb. This overall rate of increase in production has been fairly steady, apart from a natural decline during the depression years resulting from decreased activity in soap plants. The accompanying figure shows this production increase graphically.

As glycerine is a byproduct of the soap making and fat splitting industries, it follows that its production is limited to the amount available in the oils and fats consumed in these industries. During recent years the overall recovery of glycerine from these consumed fats and oils has steadily increased. During the period 1928 to 1939 inclusive the average efficiency of recovery advanced from approximately 50 to 75 per cent primarily due to increased urge for production brought about by consumer demands. It has been estimated that this average yield could reach 83 per cent with existing plants if the demand were sufficient or eventually even 92 per cent if all plants operated glycerine recovery systems with the most modern installations. However it remains debatable whether all plants could

Extract from "Synthetic Glycerine From Petroleum," a paper presented before the New Orleans meeting of the American Institute of Chemical Engineers, Dec. 3, 1940.



Glycerine recovery curves (dotted area) show potential total production from the fat-splitting industry at constant yield plus glycerine from the soap industry at indicated yield. Assuming a maximum recoverable from the soap industry is 80 percent, when the production curve meets the 80 percent curve, production will have reached its practical maximum

justify such installations economically, and the fact remains that during 1939 when the impetus for production was strong the average of all plants was less than 80 per cent. It must be remembered that the census figures used here refer to all plants and processes engaged in soap production in the United States.

The shaded area on the graph represents the total amount of glycerine that could have been recovered in the soap and fat splitting industries when operating at graded efficiencies between 70 and 95 per cent. It is noteworthy that the small increase in yield effected during the past five years indicates that the maximum recovery under existing operations is already being approached.

Since the fat splitting industry (see Table I) accounts for roughly only 13 per cent of the domestic production of glycerine and since this industry has shown a fairly constant rate of production since 1931, it follows that the soap industry is the predominant producer.

From 1931 to 1938 inclusive, the yearly consumption of oils and fats in soap has not varied more than 6.3 per cent from an average of 1,400,000,000 lb. This indicated at the time a relatively steady potential glycerine production for the next few years. However, in 1939, oil and fat consumption increased to 18 per cent above the average of the preceding 8 years due to increased activity in soap manufacture. This increase took place largely in the latter half of the year and is believed to have been caused by abnormal buying stimulated by war expectations.

Table I—U. S. Production of Fatty Acid and Its Glycerine Equivalent

	Fatty Acid Production, lb.	Glycerine Equivalent, lb. Basis: 12.5 lb./100 lb. (100%)	Percentage of total U. S. Glycerine Production
1939	127,296,501	15,910,000	10.8
1938	131,732,383	16,450,000	12.7
1937	116,176,338	14,530,000	10.7
1936	132,874,558	16,600,000	13.5
1934	146,305,189	18,250,000	14.9
1933	112,167,255	14,010,000	14.6
1932	107,510,371	13,440,000	12.5
1931	126,532,183	15,800,000	14.1

While the ground is uncertain here and speculation useless this is thought to be a short term effect. It is felt by those in the soap industry (*Soap*, Mar. 1940, pp. 26–29) that, apart from such abnormal trends, no long term increase in soap production will arise during the next several years. On the contrary it may be difficult to hold production rates at present levels in view of the increasing production of synthetic detergents. The increase of municipal water softening plants with resultant decrease in soap requirements will also have its effect.

If, as seems reasonable on the basis of the above trends, it is assumed that oil and fat consumption for soap has reached a normal level of about 1,500,000,000 lb. per year and that the fat splitting industry will hold its present pace, it is calculated that glycerine production from the two industries will reach 180,000,000 lb. per year for an 80 per cent recovery or 200,000,000 lb. per year for a 90 per cent recovery, all figures being on the 80 per cent basis.

Domestic Consumption—Domestic consumption of glycerine has increased from 62,000,000 lb. in 1920 to 194,000,000 lb. in 1939, production being exceeded by consumption in all but four years during this period. The deficiency has been met by net imports averaging 14,000,000 lb. per year up to the fourth quarter in 1939. Due to abnormal foreign demands, foreign trade has reversed itself since the latter part of 1939 and showed approximately 6,000,000 lb. net exports during the first half of 1940. We may note at this point that, prior to the present disruption of world industry and markets the international position on glycerine

Table II—U. S. Production of Alkyd Resins

	Production, lb.	Est. Glycerine Equivalent, lb. (100% basis)
1939	76,471,640	10,700,000
1938	40,996,727	5,740,000
1937	61,254,019	8,560,000
1936	46,952,452	6,570,000
1935	34,312,713	4,800,000
1934	15,219,247	2,130,000
1933	9,930,705	1,390,000

Table III—U. S. Production of Cellophane-like Products

*	Production, lb.	Glycerine Equivalent, lb. (100% basis)
1937	80,000,000	14,400,000
1936	68,000,000	12,200,000
1935	60,000,000	10,800,000
1934	50,000,000	9,000,000
1933	45,000,000	8,100,000
1932	40,000,000	7,200,000
1931	30,000,000	5,400,000

* No later estimates.

production and supply was also roughly in balance. At the same time we must remember that the United States is outstanding in its consumption of soap per capita. In weighing the economic place of synthetic glycerine we may note that the average Russian consumes 5.7 lb. of soap per year as compared with the American's 25 lb.

It is noteworthy that with the exception of the depression years, glycerine consumption has leveled off or declined during periods of high prices as shown by a comparison of the consumption and price curves of the graph. The most apparent example of this effect was the decrease in consumption during 1937 and 1938 coincident with high prices. This decrease, together with imports, brought about the large increase in domestic stocks which were, by the end of 1938, at an all time high of 100,000,000 lb.

From the latter part of 1938 to the present time, glycerine prices have remained stable at approximately 12c. per lb. The effect of this stabilized price, associated with the general rise of manufacturing activity, is reflected in the advance of glycerine consumption from 145,000,000 lb. in 1938 to 194,000,000 lb. in 1939 as shown in the accompanying chart.

While glycerine is used in innumerable industries, about half of the domestic consumption is used in the manufacture of alkyd resins, for coating materials such as cellophane and parchment, in tobacco, and in explosives containing nitroglycerine. The first two industries are relatively new and are expanding with resultant increases in glycerine consumption (see Tables II and III). It is estimated that the consumption of glycerine by these two industries alone is of the order of 25,000,000 lb. per year and is increasing at a rate of 3,000,000 to 4,000,000 lb. per year.

It should be mentioned, as a parallel to the overall decline in glycerine production in 1937 and 1938 during the period of high glycerine prices, that production of alkyd resins which had increased rapidly from 10,000,000 lb. in 1933 to 61,000,000 lb. in 1937 dropped suddenly to 41,000,000 lb. in 1938, but increased again to 76,000,000 lb. in 1939 coincident with the present period of stabilized glycerine prices. This appears too great a recovery to be accounted for merely by the general increase of business activity. It is also highly probable that the experience of high glycerine prices in 1937–8 played a not inconsiderable part in inducing explosives manufacturers to incorporate larger proportions of dinitroglycol in the nitroglycerine type explosives.

It is apparent that future increases in glycerine consumption will be largely dependent as much on price stability as on a reasonable price level.

Under these circumstances the opportunity for a synthetic process appears to lie in its power not only to stabilize prices but also to guarantee a virtually inexhaustible potential supply of high grade glycerine at a reasonable price. The realization of this fact will in our opinion tend to act as a stimulus to industrial developments leading to new uses of glycerine — developments which might never be embarked upon in the absence of such guarantees.

Glycerine Intermediates

Shell's synthetic glycerine process (described last month in *Chem. & Met.*) has made available a number of intermediates and derivatives formerly made in quantity only by synthesis from glycerine itself. The uncertainty of glycerine prices undoubtedly has hampered their development, although from time to time a few derivatives have been offered. Thus the present work offers the possibility of developing a wide range of glycerine derivatives on a sound basis both scientifically and economically.

Allyl chloride itself is a versatile compound well adapted for synthetic work. The chlorine atom is extremely labile so far as metathetical reactions are concerned, yet the tendency for elimination of HCl from the molecule is very slight, so that byproduct olefine formation is almost nil. At present allyl chloride is being used for the synthesis of derivatives such as the alcohol, the isothiocyanate (mustard oil), barbiturates, amines, and cyclopropane.

Allyl alcohol is readily oxidized to acrolein:

$$H_2C = CH - CH_2 - CH + 1/2\,O_2 \longrightarrow H_2C = CH - CHO + H_2O$$

The conjugated system of double bonds in acrolein makes for 1–4 additional reactions and can lead to a wide variety of compounds. The polymers of acrolein, of course, are well known. Allyl esters are prepared easily from the alcohol, and are used for the manufacture of perfumes and resins.

Epichlorohydrin is undoubtedly the most interesting of the intermediates so far as the synthesis of glycerine derivatives is concerned. Fortunately this chlorine-containing epoxide is readily isolated and actually more easily obtained than glycerine itself. The reactivity of epichlorohydrin lies in its epoxide ring, and generally speaking any compound with an active hydrogen atom can be made to open the ring in the following manner:

$$RH + H_2C(O)\,CH - CH_2Cl \longrightarrow RH_2C - CH(OH) - CH_2Cl$$

The resulting chlorohydrin can then be reacted further, so that an unlimited number of glycerine derivatives becomes readily available.

In the accompanying table a few of these compounds are listed together with some of their physical constants. It is to be expected that many of these derivatives will find use in the solvent, plastics, and pharmaceutical fields, and as intermediates for further synthesis.

Glycerine Intermediates and Derivatives

Compound	Formula	Boiling Point	Density 20/4
Allyl chloride	$CH_2{=}CH{-}CH_2Cl$	44.9	0.9374
Trichloropropane	$CH_2Cl{-}CHCl{-}CH_2Cl$	156	1.3905
Allyl alcohol	$CH_2{=}CH{-}CH_2OH$	96.9	0.8520
Allyl isothiocyanate	$CH_2{=}CH{-}CH_2NCS$	151	
Allyl ether	$(CH_2{=}CH{-}CH_2{-})_2O$	94.3	0.8059
Allyl mercaptan	$CH_2{=}CH{-}CH_2SH$	90	
Allyl amine	$CH_2{=}CH{-}CH_2NH_2$	53	
Acrolein	$CH_2{=}CH{-}CHO$	52.4	0.340
Allyl propionate	$CH_2{=}CH{-}CH_2{-}O{-}CO{-}C_2H_5$	124	
Diallyl phthalate	$C_{14}H_{14}O_4$	145 (1 mm.)	
β-chloro allyl alcohol	$CH_2{=}CCl{-}CH_2OH$	153	
Epichlorohydrin	$\overline{OCH_2{-}CH}{-}CH_2Cl$	117	1.1801
Dichlorohydrin (1,2)	$CH_2Cl{-}CHCl{-}CH_2OH$	182	1.3616
Dichlorohydrin (1,3)	$CH_2Cl{-}CH(OH){-}CH_2Cl$	175	1.3645
Glycidol	$\overline{OCH_2{-}CH}{-}CH_2OH$	55 (10 mm.)	1.1151
Glycidyl isopropyl ether	$\overline{OCH_2{-}CH}{-}CH_2{-}O{-}C_3H_7$	137	0.9185
a-Isopropyl ether of glycerol	$C_3H_7{-}O{-}CH_2{-}CH(OH){-}CH_2OH$	88 (4 mm.)	1.0189
Di-isopropyl ether of glycerol	$C_3H_7{-}O{-}CH_2{-}CH(OH){-}CH_2{-}O{-}C_3H_7$	97 (20 mm.)	0.9123
a-Methyl a'phenyl ether of glycero	$CH_3{-}O{-}CH_2{-}CH(OH){-}CH_2{-}O{-}C_6H_5$	278	1.1036

Improvements Introduced in Mills-Packard Chambers

ANDREW M. FAIRLIE
Consulting Chemical Engineer, Atlanta, Ga.

Chem. & Met. INTERPRETATION

Most recent chamber sulphuric acid construction in the United States has employed the Mills-Packard type of truncated, conical, water-cooled chamber which requires only about 40 percent of the chamber volume needed by a conventional box chamber plant. The author briefly reviews improvements that have been made in recent years in Mills-Packard installations, and describes in more detail the means by which the two latest installations have increased the water cooled area and reduced chamber pan depreciation.—*Editors.*

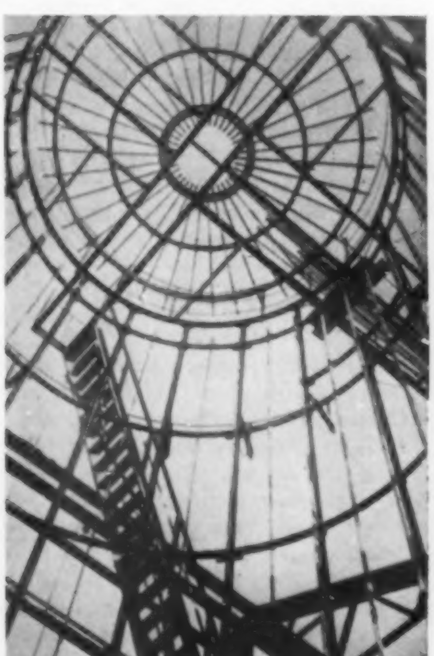
Mills-Packard water-cooled sulphuric acid chambers were first used in England, the earliest plant having been built in 1914. The chambers were built in the shape of a truncated lead cone over the surface of which cooling water was distributed. Earlier design required redistribution of the water at several levels owing to the method of supporting the lead curtains. Furthermore, in the older chambers, it was impossible to water cool the walls of the acid pan. Such pans were sometimes of the luted type, and sometimes burned on, but in both cases it was necessary to place a water collecting trough above the top of the pan owing in the first instance to the need for preventing water from flowing into the lute, and in either case to the fact that the customary method of reinforcing the pan was to brace a number of boards suitably against the outside of the pan upstand.

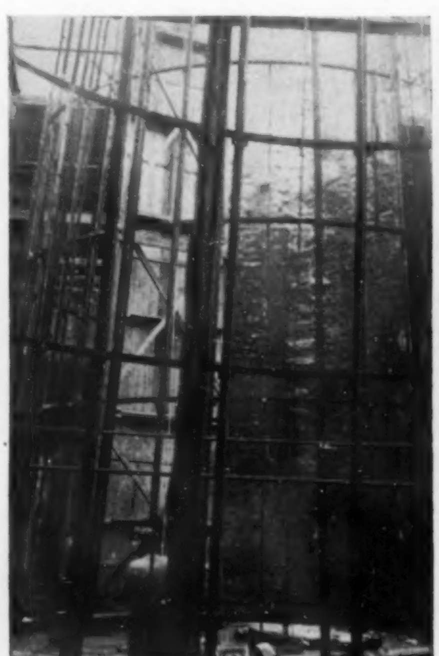
Improvements made until recently were described completely by the author in a paper before the American Institute of Chemical Engineers (*Trans.* A.I.Ch.E., 33, 569, 1937; abstracted at length in *Chem. & Met.*, Dec. 1937, p. 728-732.). For example, a new method of supporting the lead curtains eliminated the water redistributing troughs at various levels. Extremely large chambers, greater than 28 or 30 ft. bottom diameter, were found to be less efficient than those of less than 28 ft. bottom diameter. Hence, for installations where the number of small chambers would become excessive, a new divided chamber was designed to retain the advantages of the small chamber, yet occupy about the same space as the large chamber. This was accomplished by what may be described as splitting the large chamber down the middle and moving the two halves apart to provide an alley between. At present, standard chamber sizes are approximately 7,000, 12,000 and 19,000 cu. ft., with 37,000 cu. ft. divided chambers as an alternate arrangement for groups of the largest single chambers.

The most recent improvements are found in two new installations, one of four chambers completed in January 1940 for the American Zinc Co. of Illinois at East St. Louis, Ill., and the other of two new chambers for the Farmers' Fertilizer Co., Columbus, Ohio. The first chamber of this last installation was completed in May, 1940, the second in December of the same year.

The new features, for which patents are pending, encompass a method of supporting the sides of

Mills-Packard chamber in various stages of construction, with steel framing (view looking up) at left; lead curtain being placed with aid of movable wood form, at center; and part of two completed chambers, at right





the chamber pan, to permit its being water cooled. The braced boards formerly used to prevent the outward bulging of the lead have now been discarded in favor of a series of upstanding ribs of either hard or soft lead, which are burned to the pan upstand about 2 ft. apart around its circumference. Each rib, about 1½ to 2 in. wide, is as high as the pan upstand. The ribs are encircled by one or more adjustable iron or steel bands, resting in notches in the ribs. This construction makes it possible to locate the trough for the collection of the warmed water at a point below the top of the pan upstand, and preferably on the chamber floor.

Owing to the new construction the cooling water is now able to flow to the bottom of the chamber, instead of being interrupted at or above the top of the pan upstand, increasing the area of water-cooled surface by 5 to 10 percent, depending on the size of the chamber. The walls of the pan, and the acid contained in it, which were not formerly even air cooled, are now water cooled; and the most rapidly corroded part of the chamber, that is, the angle formed by the junction of the pan bottom with the pan upstand, is now water cooled.

The accompanying views are some of those taken during construction of recent Mills-Packard installations.

The new type chambers are suitable for the construction of new Mills-Packard plants; for increasing the capacity of existing box chamber plants; or for the replacement of worn out box chambers.

Compared with the old fashioned air cooled box chamber, the Mills-Packard type lowers construction cost by about 43 percent, while it reduces operating cost by the compactness of the installation; by decreasing maintenance through use of much less lead and through water cooling of the lead; and by lowered fixed charges owing to lesser investment and a smaller fire insurance rate. Cooling the chambers also lessens the effects of atmospheric changes, so that daily output is only slightly less in summer than in winter.

Opposed to these advantages is the cost of cooling water. For the 19,000 cu. ft. chamber, about 18 g.p.m. of water is required, or about 2,000 gal. per net ton of 60 deg. Bé. acid produced. When the warm water must be cooled in a spray pond or tower and recirculated, the make-up water requirement is about 120 gal. per ton of product.

Opportunities for Chemical Engineers in Fuel Technology

H. J. ROSE *Mellon Institute of Industrial Research, Pittsburgh, Pa.*

LATEST FIGURES on enrollment by courses in the 53 mineral technology schools of this country show that there were a total of 3,538 undergraduate and graduate students enrolled in petroleum and natural gas courses. In solid-fuel technology the total was 24 students! This is in spite of the fact that there are four times as many men employed in the latter industry.

Just what meaning does this have to chemical engineers? How might they fit into this new field?

To-day, the coal industry is suffering from an acute shortage of fuel technologists. Our universities are only beginning to recognize this need, and to date few courses have been offered in the field. It will be many years before the supply of technical graduates who definitely look forward to working in these industries will equal the potential need for such men.

For the present, coal and related companies have but one alternative. They must take graduate engineers from other fields and supply them the training necessary for the conversion. It has been found that chemical engineers are particularly well qualified to handle many types of fuel problems. Chemical engineering enrollments have been growing at such a rapid rate that concern has been expressed about the possibility of placing all of the future graduates. It is suggested that a reasonable number of chemical engineering students would find it worth while to consider employment opportunities in some phase of fuel utilization, and to take some additional fuel courses with this in mind.

There are many reasons for this new demand. Every phase of mining, preparing, marketing and utilizing coal is constantly becoming more technical and complex. National defense measures are exerting the heaviest demands on all phases of this key industry.

Recent achievements in the production of new synthetic products and chemicals have opened up manufacturing opportunities for which both anthracite and bituminous coal are ideally suitable as the starting point.

There are many other opportunities in the processing and utilization of solid fuels that have been scarcely touched in this country. The use of certain types of powdered fuel in Diesel engines is much more attractive technically than might be supposed at first thought. Slagging gas producers using extremely low-grade fuels, often with the recovery of metallic values, have been successful abroad but are practically unknown in this country.

The modern selling of coal has become so technical and competitive that qualified combustion engineers are needed to work with the sales departments of large coal producers and wholesale distributors.

Coal is perhaps less understood by buyers and sellers than any other major raw material. Through ignorance, it has too often been bought and sold merely on price instead of on value. Fortunately, coal producing and sales companies now realize that coal should be sold on its merits.

Manufacturers of coal handling and industrial furnace equipment are another source of employment. Byproduct coke and manufactured gas plants use technical graduates of chemical engineering schools extensively for operation and management.

There are a number of companies engaged in the design and manufacture of commercial heating equipment who need engineers with fuel training, both at the factory and for sales.

Published figures and observation indicate that the scale of earnings of men in the technical, supervisory, and management phases of fuel production and utilization are equal or better than those in other basic industries. Owing to the shortage of capable and well-trained men, and the far-reaching technologic changes that are in progress, opportunities for advancement in this field are unprecedented.

Based on Lecture IV of the Mellon Institute Technochemical Series, presented Nov. 14, 1940. Reported by J. R. Fisher.

Cotton Linters as a Source Of Chemical Cellulose

GEORGE D. BIEBER * *School of Business Administration, University of Pittsburgh, Pittsburgh, Pa.*

Chem. & Met. INTERPRETATION

The United States is the world's largest producer of cotton linters, a byproduct of the cottonseed industry. Approximately 50 percent of the annual consumption is utilized by the chemical industry in the production of rayon, dopes, films, lacquers, plastics and pyroxylin coated textiles. For two decades the annual supply has proved adequate to meet normal demands. However, the augmented quantities of nitrocellulose explosives required by the national defense program probably will severely strain this equilibrium.—*Editors.*

COTTON LINTERS, the fuzzy material adhering to cottonseed after ginning, did not become commercially significant until about sixty years ago when cottonseed processors realized it was advisable to remove some of these short fibers in order to reduce the quantity of oil lost through absorption. But until World War I and the advent of the rayon industry, the American cottonseed industry had never progressed very far toward efficient removal of linters.

This by-product has long been utilized as a stuffing material in the production of mattresses, comforts, cushions and upholstery. Cotton linters was not used extensively by the chemical industry, however, prior to the large-scale production of nitrocellulose explosives during World War I. At that time the Federal government licensed all cottonseed mills so as to control the production of a maximum amount of linters, an accomplishment never before attained in regular commercial practice.

The cessation of hostilities destroyed this market for the fiber. The era that followed the war, however, witnessed the development of a number of new industries using various grades of cotton linters as raw materials. These enterprises include rayon, cellulose lacquers, cellulose plastics, and pyroxylin-coated textiles, as well as explosives. Today cotton linters is strategic both in war and peace.

The removal of the fiber from cottonseed is accomplished by means of a gin of the same general design as that employed in the separation of the staple cotton (lint) from seed cotton. Circular saws, set close together and revolving at high speeds, pull the linters through ribs too small to allow the seed to pass. This reginning process is usually spoken of as "delinting." The quality of cotton linters is largely determined by the number of pounds removed per ton of seed processed, and the trade classifies them into three major grades as follows:

1. First cuts: a light ginning removing the longest fibers. Cuts range from 30 to 75 lb. per ton of seed.
2. Mill runs: a heavier ginning removing from 100 to 175 lb. or more per ton of seed.
3. Second cuts: the cottonseed, after removal of the first cut, is subjected to a second ginning, producing an additional 100 to 150 lb. of short fibers per ton of seed.

The annual domestic production of cotton linters from 1899 to 1938, inclusive, and the rate of growth using the output of 1899 as a base of 1.00, are shown in Table I.

The percentages of first cuts, second cuts and mill runs for recent crop years are shown in Table II. An examination of the table reveals that second cut linters, the grade principally consumed by the chemical industry, represents from 45 to 56 percent of the total quantity produced.[1]

The United States has been the largest producer of linters and in recent years has exported approximately 200,000 to 250,000 running bales annually. Imports have been negligible to date, but there is a tendency for them to increase.

Table I—Cotton Linters Production (1899-1938)

Growth[1] Year	Running Bales Produced[2]	Rate of Growth (1899 = 1.00)
1899	114,544	1.00
1905	230,497	2.06
1910	397,628	3.47
1915	944,640	8.25
1916	1,300,163	11.36
1917	1,096,422	9.58
1918	910,236	7.95
1919	595,093	5.20
1920	429,005	3.75
1921	382,375	3.34
1922	590,537	5.16
1923	639,540	5.58
1924	857,962	7.50
1925	1,044,495	9.12
1926	1,041,864	9.05
1927	875,121	7.65
1928	1,085,766	9.47
1929	1,038,170	9.05
1930	823,944	7.19
1931	875,667	7.64
1932	741,401	6.48
1933	800,526	7.00
1934	805,083	7.02
1935	876,215	7.65
1936	1,126,873	9.84
1937	1,470,528	12.82
1938	1,115,916	9.75

[1] The cotton season begins August first and ends the following July thirty-first.
[2] For statistical purposes a running bale of cotton linters is assumed to be a package of the raw material weighing 625 pounds.
Data of the U. S. Dept. of Commerce, Bureau of the Census, *Cotton Production and Distribution.*

Table II—Percentages of First Cut, Second Cut and Mill Run Linters Produced during the Crop Years 1930 to 1939

Growth Year	First Cut	Second Cut	Mill Run
1930	16.9	51.3	31.8
1931	17.6	46.4	36.0
1932	17.1	45.8	37.1
1933	17.8	48.6	33.6
1934	19.5	48.6	31.9
1935	21.6	48.8	29.6
1936	24.4	47.3	28.3
1937	24.4	51.5	24.1
1938	23.8	56.2	20.0

Calculated from data of the U. S. Department of Commerce, Bureau of the Census.

*Fellowship Assistant, Multiple Fellowship of the Cotton Research Foundation, Mellon Institute of Industrial Research, Pittsburgh, Pa. This paper is based on a thesis presented in partial fulfillment of the requirements for the M.A. degree. This work was made possible through a Scholarship in Chemical Economics supported by the Cotton Research Foundation, Memphis, Tenn., the research agency of the National Cotton Council.

[1] Second cuts are used by the chemical industry because they are cheaper than the other two grades and just as suitable for bleaching purposes.

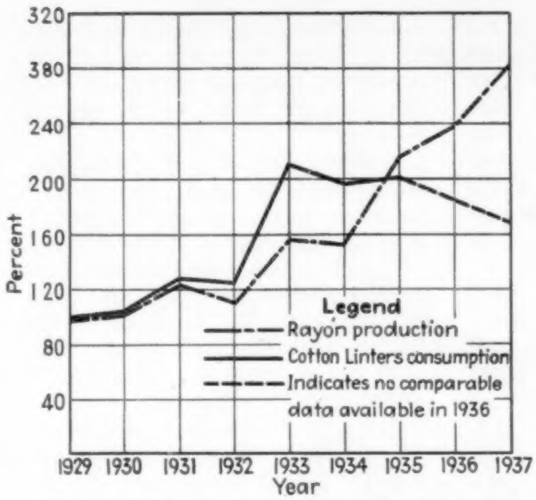


Fig. 2—Index of rate of rayon production and cotton linters consumption; 1929 = 100

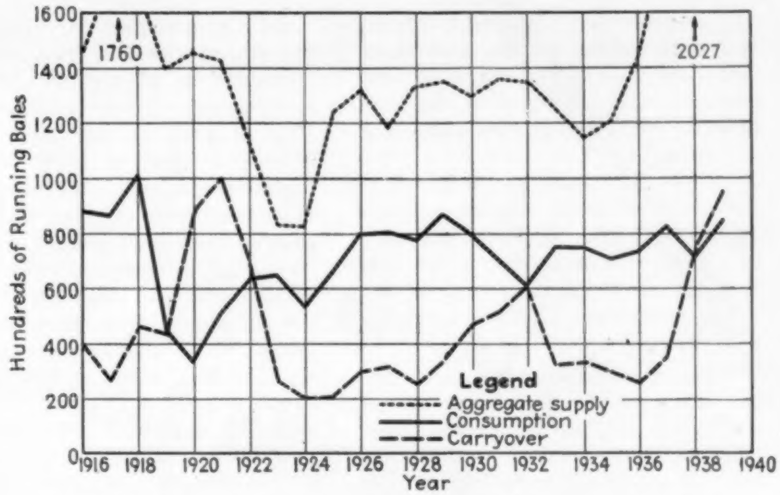


Fig. 3—Aggregate supply, consumption and carryover of cotton linters (1916-1939). Data from U. S. Dept. of Agriculture

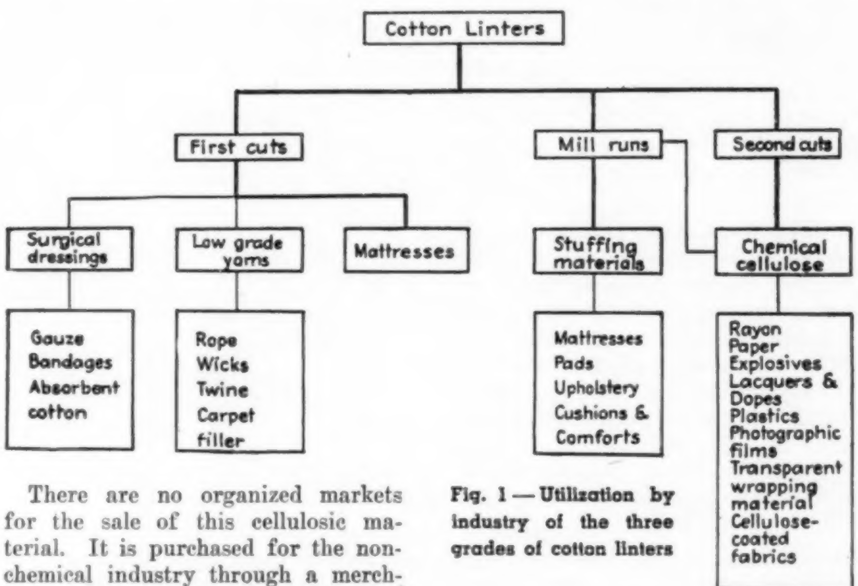


Fig. 1 — Utilization by industry of the three grades of cotton linters

There are no organized markets for the sale of this cellulosic material. It is purchased for the non-chemical industry through a merchant or broker on the basis of samples drawn from specific lots. When utilized for chemical purposes it is either bought directly from oil mills or through brokers.

Fibers destined for consumption in the chemical industry are analyzed for their cellulose content, usually by a method approved by the American Oil Chemists' Society. Seventy-three percent of cellulose is at present taken as the basis grade, with premiums or discounts of one dollar per ton for each one percent differential. Linters containing less than 70 percent of cellulose may be rejectable under standard contract provisions.

The aggregate supply (annual production plus carryover of previous year), consumption and carryover of cotton linters are given in Fig. 3.

Linters is used as a raw material in the manufacture of many products. The consumers of the fiber fall into four main classes: the chemical, automotive, mattress, and furniture industries. There is no agency at present which compiles separate data on consumption by these four groups. Table III, however, shows a breakdown of the estimated utilization of the primary product in the above-mentioned industries for the 1937-1938 crop year. There is reason to believe that the consumption of the fiber in this year is representative. On this assumption, it should be noted that the chemical industry under normal conditions uses about 50 percent of the total quantity.

Table III—Annual Domestic Consumption of Cotton Linters for the Crop Year 1937-1938

Industry	Running Bales
Chemical	382,000
Automotive	130,000
Furniture	50,000
Mattress	150,000
Total	712,000

Rayon Industry.—As will be seen later, the rayon industry is the largest user of that portion of the fiber consumed by the chemical industry. Table IV presents the annual consumption of this raw material in the making of synthetic fibers according to process of manufacture.

In view of the phenomenal growth of rayon, it would normally be expected that the quantity of linters consumed in this industry would increase proportionally (Fig. 2 above). This relationship was apparent from 1929 to 1935 and would probably still hold were it not for the fact that linters in recent years has had to share the market with purified wood pulp. Table V presents the percentage of cotton linters utilized as a ratio of the total pulp consumed in each process.

In the viscose process, which in the last eight years has accounted for from 70 to 80 percent of the total rayon produced in the United States, cotton linters and wood pulp compete on a price basis. Even in the early days of manufacture, viscose producers discovered that they could blend cotton linters with the cheaper sulphite wood pulp. But research proved that under existing price relationships viscose rayon could be manufactured more economically by decreasing the linter pulp content. At present most viscose producers are not using the latter at all. On the other hand, both the acetate and cuprammonium processes have been using cotton linters practically exclusively.

Therefore it is obvious that, assuming that technological and price factors do not change, the future of cotton linters in the rayon industry will depend largely upon the quantity of acetate rayon produced. It is generally recognized by industry, however, that cotton linters must be

used to produce a high quality rayon. Hence it should not be overlooked that these specialty yarns may also consume large amounts of the raw material when and if they come into widespread use.

Linters has served as the raw material for cellulosic sausage casings. Further research developments may cut down the consumption in this industry since attention is being directed toward the production of protein casings.

Plastics Industry.—The most important cellulose plastics are those made from cellulose acetate and nitrocellulose. No exact data on the quantities of cotton linters utilized in their production are available. The Bureau of the Census, however, furnishes data on the production of these plastics. From this information and from the assumptions that the percentage of cellulose acetate in the plastic is 60 and that approximately 0.66 lb. of purified cellulose is necessary to produce one lb. of cellulose acetate, the annual consumption in this type of product can be estimated. Similarly, 0.65 lb. of the raw material is required to produce one lb. of nitrocellulose and the percentage of nitrocellulose in the plastic can be taken as 74. Table VI presents the quantity of linters consumed in the production of cellulose acetate and nitrocellulose plastics estimated by use of these factors which have been checked with various authorities in the industry.

An examination of this table brings out the fact that the older nitrocellulose plastic industry, after experiencing adverse conditions from 1931 to 1935, rallied from 1935 to 1938 and again in 1939. Cellulose acetate sheets, rods, and tubes, on the other hand, have experienced a steady growth from 1933 to 1937. In 1938 production of these plastics was decreased greatly. This decrease, however, was more than offset by the introduction of cellulose acetate molding powder, which consumed 7,100 running bales of linters during the latter year. The increasing importance of related derivatives, such as the aceto-butyrate, warrants the belief that this outlet for linters will continue to expand. Judging from the experience in Great Britain respecting the utility of cellulose triacetate in aviation, there is reason to believe that the market for this compound will expand materially. In 1939 the total quantity of fiber consumed in the plastics industry reached an all-time high of 30,260 running bales.

Pyroxylin-Coated Textiles and Nitrocellulose Explosives.—In a similar manner the annual consumption of linters in the pyroxylin-coated textile and explosive industries was calculated from data of the Bureau of the Census and the Bureau of Mines. Table VII gives these estimates from 1931 to 1939, inclusive.

Pyroxylin-coated textiles are expected to experience increasing competition from other coating materials as the latter come into more prevalent use, thus restricting the consumption of cotton linters in this industry.

Cellulose Dopes and Lacquers.—No attempt has been made to estimate the annual quantity of cotton cellulose consumed in the production of cellulose dopes and lacquers, because sufficient data are not available. Dr. C. M. A. Stine* states that in 1935 pyroxylin dopes, films, and lacquers utilized a minimum of 11,000 tons of cotton linters.

Total Consumption of Linters in the Chemical Industries.—On the basis of the estimates made in the previous sections, Table VIII gives the manner in which the chemical industries utilized cotton linters in the calendar years 1937 and 1939. These data show that the rayon industry used some 70 percent of the total quantity of cotton linters consumed in the chemical field.

* *Proceedings of the Second Dearborn Conference of Agriculture, Industry and Science*, p. 12, Dearborn, Mich., Farm Chemurgic Council (1936)

Table VII—Running Bales of Cotton Linters Consumed in the Production of Pyroxylin-Coated Textiles and Nitrocellulose Explosives (1931-1939)

Year	Pyroxylin-coated Textiles	Nitrocellulose Explosives
1931	4,130	850
1932	3,180	490
1933	4,450	560
1934	5,580	710
1935	6,710	690
1936	8,080	910
1937	8,550	1,000
1938	6,740	.....
1939	8,170	.....

Table V—Percentage of Cotton Linters Utilized as a Ratio of Total Pulp Consumed in Each Process in the United States

Year	Percentage of Linters Pulp Consumed: Viscose and Cuprammonium	Acetate	Nitro-cellulose	Total
1929	29	100	100	36
1930	30	100	100	36
1931	31	100	100	37
1932	32	100	100	41
1933	36	100	100	46
1934	35	100	100	44
1935	27	100	†	37
1936	‡	100	†	‡
1937	9	100	†	23

† Production discontinued in 1934. ‡ Data not available.
Report on Development and Use of Rayon and Other Synthetic Fibers, op. cit., p. 15.

Table VI—Consumption of Cotton Linters in the Production of Cellulose Acetate and Nitrocellulose Plastics* (1929-1939)

Year	Cotton Linters Consumed in Running Bales, Cellulose Acetate: Sheets, rods, and tubes	Molding Powder	Nitrocellulose Sheets, rods, and tubes	Total
1929	......	......	13,080	13,080
1931	......	......	9,240	9,240
1933	2,380	......	9,170	11,550
1934	4,630	......	9,525	14,155
1935	10,100	......	12,460	22,560
1936	12,500	......	13,040	25,540
1937	12,700	......	13,650	26,350
1938	6,600	7,100	8,900	22,600
1939	8,800	11,180	10,280	30,260

* Because it is impossible to determine accurately the displacement of linters by wood pulp, and also because the quantity is not considered of sufficient magnitude to affect seriously any conclusions reached on the basis of 100 per cent cotton linters, the above estimates were made on that assumption.

Table IV—Approximate Domestic Consumption of Linters in the Manufacture of Synthetic Fibers by Processes (1929-1937)

Year	Linters Pulp in Thousands of Tons: Viscose and Cuprammonium	Acetate	Nitro-cellulose	Running Bales Consumed*
1929	18	3	4	120,000
1930	20	3	3	125,000
1931	24	5	3	154,000
1932	21	6	4	149,000
1933	35	14	4	254,000
1934	34	13	2	236,000
1935	32	18	†	246,000
1936	‡	21	†	‡
1937	14	28	†	202,000

* Calculated on the basis that 1.5 lb. of linters yields 1.0 lb. of pulp.
† Production discontinued in 1934.
‡ Data not available.
Report on Development and Use of Rayon and Other Synthetic Fibers, p. 13, Washington, D. C., Department of Agriculture, October, 1938.

Table VIII—Quantities of Cotton Linters Consumed in the Chemical Industries (1937 and 1939)

Products	1937 Running Bales	1937 Percentage	1939 Running Bales	1939 Percentage
Rayon	202,000	70.6	255,000	74.4
Pyroxylin dopes, films and lacquers	35,000a	12.2	35,000a	10.2
Cellulose acetate plastics	12,700	4.4	19,980	5.8
Nitrocellulose plastics	13,650	4.8	10,280	3.0
Sausage casings	10,400	3.6	10,400	3.0
Pyroxylin-coated textiles	8,550	3.0	8,170	2.4
Transparent sheeting	3,000b	1.1	3,000b	0.9
Explosives	1,000	0.3	1,000c	0.3
Total	286,300	100.0	342,830	100.0

a Assumed to be the same as in 1935.
b Rough approximation.
c Assumed to be the same as in 1937.

Chemical Man-Power For National Defense

SUMMARY AND CONCLUSIONS

About 65,000 to 70,000 men will be needed to man America's munitions plants. Something like 4,000 of them must be chemically trained. This large requirement in addition to redoubled needs of the rest of chemical industry and heavy Governmental needs threatens to produce a "bottleneck" next summer. The only solution is to establish intensive training programs and do so quickly. Government is willing to help and has appropriated millions of dollars to do so, but industry must take the initiative. The first job is to evaluate the personnel demand, analyze the supply, then study Government training programs to see which one best satisfies the particular requirement.

Evaluating Personnel Demand

Sizing up the 1941 personnel problem for all of chemical industry is difficult because it involves so many indeterminate factors. National defense means more than munitions plants. It means new construction by private capital and overloading existing plants to supply the enormous needs of chemical raw materials. What the total man-power requirement will be is a big question-mark. Smokeless powder, high explosives, and ammunition loading plants alone are estimated to require 65,000 to 70,000 workers under the present munitions plan. About 4,000 of these must be chemically trained men for various supervisory jobs and chemical control. In addition to this huge requirement for plant operation, the Army will probably need upward of 2,000 chemically trained inspectors.

This 6,000 man requirement added to the unknown thousands needed by other chemical and equipment manufacturers for national defense and for industry's normal annual replacements, will produce a personnel shortage hitherto unknown in chemical circles.

Until now the probable personnel shortage of professional chemical workers has been obscured by the more serious shortage of machinists, mechanics, and other skilled shop workers. Even Government agencies which would normally anticipate labor demands for chemical industry have spent all their time and facilities on other industries such as airplanes, airplane motors, machine tools and shipbuilding. That is logical and necessary, but it puts chemical industry in a position of responsibility for its own labor problems. Unless steps are taken immediately to provide necessary training, a shortage cannot be avoided.

Summer Shortage—Next summer is the time when the pinch will come. The first six months of 1941 will be a time of big expansion. Many plants will be in the construction stages. They will require chemical engineering designers and equipment specialists. In general, the construction companies themselves do not have large staffs of chemical engineers. When they receive plans for a plant, chemical engineering has already been done by the operating companies in most cases. Problems of mechanical and civil engineering are left to the builder. The big need, therefore, will be for superintendents, supervisors, foremen, plant engineers and chemists when the plants are completed.

Every effort is being made to finish munition plants ahead of schedule because it is likely that many more will come later. DuPont's Memphis powder plant for the British has been operating for more than a month. Part of the Charlestown, Ind., smokeless powder works will be ready this spring. Radford, Va., powder plant (Hercules) will be ready early in the summer. But the big high explosives plants (Wilmington, Ill. and Weldon Springs, Mo. and Sandusky, Ohio) will not go into operation until Fall.

Companies operating these plants are now, and have been for six months, recruiting technical men. They have organized comprehensive training programs in conjunction with existing powder and TNT plants and are giving the new men both plant and classroom education.

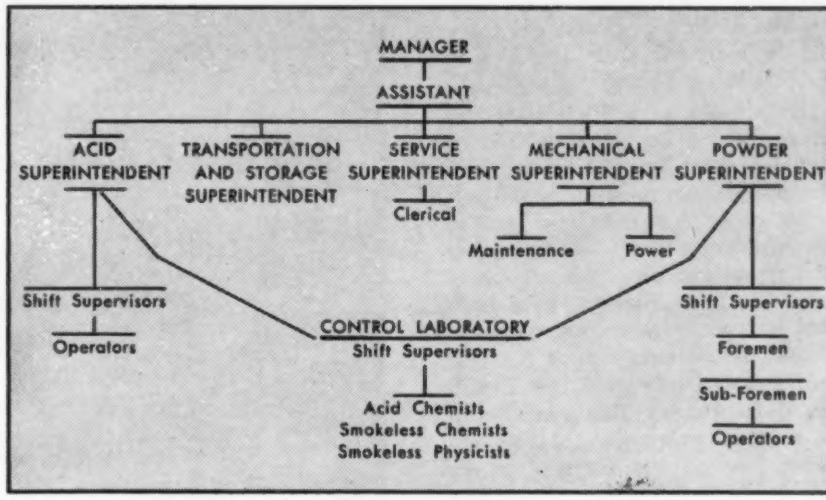
Of course, many of the men thus trained have been recruited from present employees. One company made not one but three thorough studies of its technical personnel to find men who might be adapted to this type of work. They looked for production-minded men because making munitions is a production job. It involves no sales or research efforts.

The foregoing remarks have been predicated on the present defense planning. If the authorities consider it necessary to put preparedness on the basis of a 4,000,000 man army instead of 2,000,000 men—and that decision is more likely than not—then personnel procurement will be doubly hard. Total construction and equipment cost of the powder and ammunition plants underway at the start of the new year was in excess of $300,000,000. Operating funds already allotted to these plants as orders for finished products totaled another $350,000,000. Yet to come are munitions works costing in excess of $150,000,000 under present appropriations. However, it is expected that the President will soon

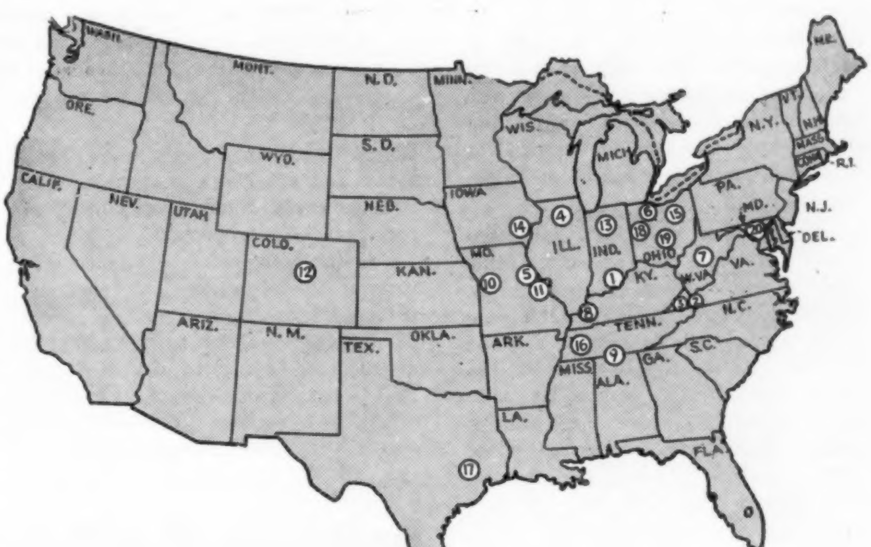
ask Congress for additional appropriations to build a second large-scale chain of munitions plants. It is likely that most of these will be located west of the Mississippi river just as the first group was located east of the river. First significant move in that direction was the recent announcement of a small arms ammunition plant for Denver, Colo., to be operated by Remington Arms.

Every day the status of the defense program changes, but at the time this report was prepared (Jan. 10, 1941), contracts awarded by the War Department included the plants in the accompanying tabulation. A discussion of the newer contracts appears elsewhere in this issue (p. 117).

Munitions Plants — Four smokeless powder plants are being built (one at Memphis, Tenn., is operated by du Pont for the British). They will employ about 22,000 men altogether, of which more than 1,000 will necessarily be chemically trained. Smokeless supervisors, foremen, chemical engineers and acid supervisors and chemists, are the principal classifications into which these men will fall. Two companies said that they planned to use chemical engineers as long as they are available because they are more mechanical minded. Chemists will be used in the laboratories and on the supervisory staffs when chemical engineers are no longer obtainable. It will probably be necessary to fill in the ranks of the foremen and sub-foremen with non-technical men who



Typical organization chart for a Government-owned smokeless powder plant



Revised Table of the Army's Munitions Plants Corrected to January 10, 1941

Type	Contractor	Cost	Operator	Operating Funds[1]	Location	Map
Smokeless Powder	DuPont	$74,000,000	DuPont	$23,000,000	Charlestown, Ind	1
Smokeless Powder	Hercules Powder	36,390,000	Hercules	24,500,000	Radford, Va	2
Smokeless Powder	* Const.*	* *	*	*	Childersburg, Ala.	
Bag Loading	Equip. Goodyear	2,373,446	Goodyear Engrg. Corp.	11,526,095	Charlestown, Ind	1
Bag Loading	*	*	Hercules	6,800,000	Pulaski, Va	3
Bag Loading	*	*	*	*	Childersburg, Ala.	
TNT-DNT-Tetryl	Stone & Webster	31,000,000	DuPont	17,700,000	Wilmington, Ill	4
TNT-DNT	Fraser-Brace Engineering Co.	11,325,000	Atlas Powder	6,400,000	Weldon Springs, Mo	5
TNT-DNT	*	11,000,000	Trojan Powder	*	Sandusky, Ohio	6
Ammonia	DuPont	15,000,000	DuPont	*	Morgantown, W. Va	7
Ammonia	*	12,000,000 est.*	Solvay Process Co.	*	Kentucky (prob.)	8
Ammonium Nitrate	TVA	6,500,000	TVA	*	Muscle Shoals	9
Small Arms Amm	Constr.-Foley Bros. & Walbridge, Aldinger Co.	7,500,000	Remington Arms	60,000,000	Kansas City, Mo	10
	Equip.-Remington Arms	13,500,000				
Small Arms Amm	Constr.-*	18,600,000	U. S. Cartridge	87,250,000	St. Louis, Mo	11
	Equip.-Western Cartridge					
Small Arms Amm	Constr.-*		Remington Arms	87,449,880	Denver, Colo	12
	Equip.-Remington Arms	14,800,000				
Ammunition Loading	Bates & Rogers	11,500,000	Todd & Brown	26,800,000	Union Center, Ind	13
Ammunition Loading	A. Guthrie & Co. Al Johnson Constr. Co.	9,900,000	Day & Zimmerman	34,500,000	Burlington, Iowa	14
Ammunition Loading	Hunkin-Conkey Constr	12,000,000	Atlas Powder	28,000,000	Ravenna, Ohio	15
Ammunition Loading	Sanderson & Porter	14,500,000	Sanderson & Porter	26,200,000	Wilmington, Ill	4
Ammunition Loading	*	14,000,000	Proctor & Gamble	*	Milan, Tenn	16
Toluol	Humble Oil & Refining	11,857,000 (incl. $1,097,000 to equip existing plant under 5-year amortization)	Humble Oil	7,800,000	Baytown, Tex	17
Activated Carbon	National Carbon Co	1,000,000 est.*	National Carbon	*	Fostoria, Ohio	18
Activated Carbon	Barneby-Cheny Co	1,000,000 est.*	Barneby-Cheny	*	Zanesville, Ohio	19
Edgewood Arsenal expansion	Chem. Warfare Service	5,900,000	Chem. Warfare Service	*	Edgewood, Md	20

* Not yet announced.

[1] Operating funds are for no standard period of time. They are from Army Ordnance appropriations. Construction funds are from special defense appropriations for Government plants.

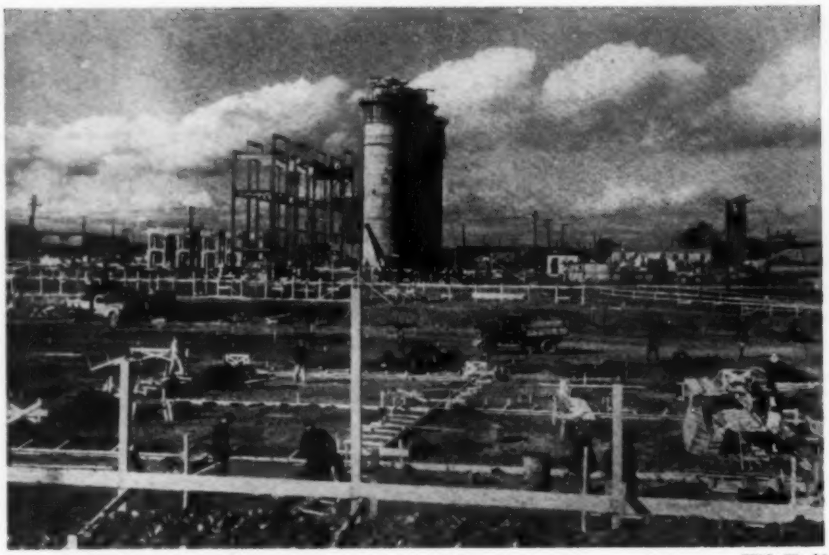
have been given intensive training. Non-skilled and non-technical labor will be recruited from the locality of the plants wherever possible.

DuPont and Atlas TNT plants together will employ about 6,500 men of which about 500 will be chemical. The proportion of technical men is higher in TNT manufacture than in powder-making and much higher than in ammunition loading. There is a still higher proportion of technical men in synthetic ammonia and ammonium nitrate plants.

In the case of ammunition loading, it is probable that women will fill a large proportion of the unskilled jobs as was the case in the World War. Certain advantages such as more careful attention to details and greater manipulative dexterity are claimed for feminine workers. There is also the advantage that they will not have to be surrendered to the army should the call for man-power there become more intensive. In an accompanying photograph women are shown at work assembling gas masks at Edgewood Arsenal.

Salaries for munitions jobs are about the same as for comparable jobs in other chemical enterprises. Personnel men do not anticipate much increase due to competition for services. As to the hazards of the industry, powder companies can show records to prove that making explosives is much less hazardous than other industries, though the same factors might not apply in wartime.

Government Service—In addition to the needs of these Government-owned industry-operated plants, the Government requires technical operating personnel. The Chemical Warfare Service may spend as much as $12,000,000 in new construction at Edgewood Arsenal. It is building several other plants (mostly for gas masks and activated carbon) in connection with privately owned plants. The Army has five other arsenals, some of them employing as many as 4,000 men. Most of these are pretty well staffed already, but they represent another unusual outlet for technical men. Army Ordnance and the Defense Commission are expanding. Some of their work is highly technical in nature. The U. S. Department of Agriculture regional research laboratories (some of them not yet finished) are not completely staffed and they may be thrown into the national defense program. The U. S. Bureau of Mines is very much concerned with the domestic production of manganese, chromium, antimony and other raw materials. Expansion there would mean more jobs for chemical engineers.



Wide World

Last summer a cornfield and tobacco patch occupied this piece of land near Charlestown, Ind. Now a $74,000,000 smokeless powder plant, biggest in the U.S.A., is being built for the Army by duPont. When completed it will give employment to 10,000 workers; more than 5 percent will be chemical men

Private Enterprise—Contracts for private construction in chemical process industries were up from $82,000,000 in 1939 to $142,000,000 in 1940 according to the McGraw-Hill Construction News Service. The total for year-end proposed work was $115,000,000. These figures indicate about a 75 per cent increase in new construction in 1940 over 1939, some of which was probably due to national defense needs. However, it must be pointed out that most of the new construction for defense has not yet been reflected in contract figures. *Chem. & Met.* editors expect 1941 to be the biggest construction year the chemical industries have ever had—even when Government plants are not included.

Analyzing Man-Power Supply

About 2,000 to 2,500 chemical engineering seniors will graduate from college this June. Some 400 students will receive advanced degrees in chemical engineering. When the graduate and post-graduate chemists are added to this group, the total will mount to more than 7,000.

Actually more than 14,000 students are enrolled in chemical engineering courses in colleges offering degrees in that course. But the Government would rather not press undergraduates into service unless there is no other solution. National defense is regarded as a continuing program—not an emergency for the next few months. If all resources of personnel raw material are depleted, an even more serious shortage may result a few years hence.

Civil Service—There are some chemists and chemical engineers unemployed. Many of these are now on the registers of the Civil Service Commission in Washington. The Commission expects these registers to be quickly depleted as the force of the demand makes itself felt, and it will probably be necessary for new examination announcements to be made shortly. Probably the $2,000 grade of junior chemists and engineers will become depleted first. The present demand, however, is for specialized technologists for production, for economic research, for design and for plant layout.

An unassembled examination (requiring no written exam) is now open for all grades of powder inspectors with stipulated salaries from $1,620 to $2,600 yearly. The principal requirement is 18 semester hours of organic chemistry, part of which may be substituted for with experience. C.S.C. examiners point out that after a man is appointed to Government service under such an examination, he may be quickly advanced or transferred and his initial

salary may soon be raised. Other unassembled examinations now open include: explosives chemist, junior engineer, engineer, and engineering draftsman. A recent announcement states that photographs are no longer required with these applications.

The Civil Service Commission does not actually make appointments to Government jobs. It examines and certifies candidates, but the department needing an employee chooses him.

Roster—Another activity of Government designed to take stock of manpower is the Roster of Scientific and Specialized Personnel. Its job is to catalog by way of questionnaire the country's resources in this type of manpower. To date the National Resources Planning Board has sent out 150,000 questionnaires, about 90,000 of which went to chemical technologists. The American Chemical Society and the American Institute of Chemical Engineers are cooperating with the Board. A.C.S. has sent 22,000 questionnaires to members, 50,000 to non-members and 16,000 to 1940 and 1941 college graduates, making up the bulk of the 90,000 mentioned above. The work on the Roster has just begun, but most of the chemical professional workers have received questionnaires and more than half have been returned.

In using this information, the Roster lists will be made available to the army (or other Government agency) which will then select the desired names and make contact with the individuals.

Selective Service—Another factor that has an important bearing on supply is selective service. It is the policy of the System's administrators in Washington that where the personnel interests of defense industries and the conscript army conflict, industry shall have priority. However, interpretation of industrial needs by local boards varies widely across the country. Unless the boards classify the chemical engineer as an employee who "cannot be replaced satisfactorily because of a shortage of persons with his qualifications" the army may take a big toll of 1941 chemical engineering graduates. This would be extremely unfortunate because it is virtually impossible to replace 4 years of technical education with a 3 months training program. It would seem more practical for the SSS to conscript the non-technical man—the power for military training (which *can* be done in a year) and defer the technical college trained men for industrial service.

Advisory Committee on Engineering Training for National Defense

(Appointed Sept. 26, 1940 by John W. Studebaker, U. S. Commissioner of Education)

Andrey A. Potter, Chairman, Dean of the School of Engineering, Purdue University
H. P. Hammond, Dean of Engineering, Pennsylvania State College
Thorndike Saville, Dean of Engineering, New York University
B. M. Woods, Professor of Mechanical Engineering, University of California
F. L. Bishop, Secretary of the Society for Promotion of Engineering Education
R. E. Doherty, President, Carnegie Institute of Technology
Gibb Gilchrist, Dean of Engineering, A. & M. College of Texas
W. O. Hotchkiss, President, Rennselaer Polytechnic Institute
R. S. McBride, Consulting Engineer, Washington, D. C.
C. C. Williams, President, Lehigh University
Allan W. Horton, Jr. (Standard Oil Co. of Calif.) Secretary of the Committee and Administrative Assistant to the director of the program.

Regional Advisers on Engineering Defense Training

Regional Adviser	Address	Area for Supervision	Region Number
Dean E. L. Moreland....	M. I. T. Cambridge, Mass.	Maine, Massachusetts, New Hampshire, and Vermont	1
Prof. L. E. Seeley........	Yale University New Haven, Conn.	Connecticut and Rhode Island.	2
Dean S. C. Hollister.....	Cornell University Ithaca, N. Y.	New York State (except New York City)	3
Dean J. W. Barker......	Columbia University New York, N. Y.	New York City and Long Island	4
Pres. A. R. Cullimore....	Newark College of Engineering Newark, N. J.	Northern New Jersey	5
W. T. Spivey...........	Drexel Institute of Technology Philadelphia, Pa.	Eastern Pennsylvania, Southern New Jersey, and Delaware	6
Dean S. S. Steinberg.....	U. of Maryland College Park, Md.	District of Columbia and Eastern Maryland	7
Dean Blake R. Van Leer..	N. C. State College Raleigh, N. C.	North Carolina, South Carolina, and Virginia	8
Prof. J. E. McDaniel.....	Georgia School of Technology Atlanta, Ga.	Alabama, Florida, Georgia, Mississippi, and Eastern Tennessee	9
Dean F. L. Wilkinson, Jr..	U. of Louisville Louisville, Ky.	Kentucky, Southern Ohio, and Southwestern half of West Virginia	10
J. D. Beatty............	Carnegie Inst. of Tech. Pittsburg, Pa.	Western half of Pennsylvania, Northeastern half of West Virginia and Western Maryland	11
Dean C. E. MacQuigg....	Ohio State University Columbus, Ohio	Northern half of Ohio	12
Dean H. B. Dirks........	Michigan State College Lansing, Mich.	Southern Michigan	13
Pres. D. B. Prentice......	Rose Poly. Inst. Terre Haute, Ind.	Indiana (except for Chicago industrial area)	14
Pres. H. T. Heald........	Illinois Inst. of Tech. Chicago, Ill.	Illinois, Southern Wisconsin, and the Chicago industrial area in Indiana	15
Prof. H. O. Croft........	U. of Iowa Iowa City, Iowa	Iowa, Minnesota, Nebraska, North Dakota, South Dakota, Northern Wisconsin, and Northern Michigan	16
Dean A. S. Langsdorf....	Washington University St. Louis, Mo.	Arkansas, Kansas, Missouri, Oklahoma, Western Tennessee	17
Dean W. R. Woolrich....	University of Texas Austin, Tex.	Louisiana and Texas (East of Pecos River)	18
Pres. M. F. Coolbaugh...	Colorado School of Mines, Golden, Colo.	Colorado and Wyoming	19
Prof. R. L. Daugherty....	Calif. Inst. of Tech. Pasadena, Calif.	Arizona, New Mexico, Southern California, and Texas (West of Pecos River)	20
Dean S. B. Morris.......	Stanford University Stanford University, Calif.	Northern California, Nevada, and Utah	21
Prof. H. H. Langdon.....	State College of Washington Pullman, Wash.	Idaho, Montana, Oregon, and Washington	22

Unskilled civilian jobs on the munitions assembly lines are often held by women because they are inclined to be more adept, more careful and are less susceptible to Army service. Edgewood Arsenal employs women for gas mask assembly

Typical 8-Weeks Basic Course in Explosives Under the Engineering College Defense Training Program

Qualifications for Admission—Two years of an engineering school course of study (graduation with an engineering degree preferred); a good course in general college chemistry.

	Total Days
a. Characteristics of military explosives, types and uses b. Organic chemistry and chemistry of explosives	12
c. Physical testing of explosives; laboratory and proving ground methods	4
d. Physical testing of loaded components and complete rounds; shell, pyrotechnics, fuses, boosters, primers, etc.	4
e. Stability tests on explosives	2
f. Manufacture and properties of explosives (1) Propellants; single base, double base, NH, FNH, strip. (2) High explosives; TNT, tetryl, mercury fulminate, lead azide, ammonium nitrate and picrate, Amatol, tridite, trimonite, black powder, primer and detonator mixtures.	8
g. Metal components, types, sizes, shapes, etc.	3
h. Loading; bag loading, shell and bombs, shrapnel, pyrotechnics, fuses, boosters, primers, etc.	6
i. Specifications and drawings	2
j. Assembling and packing	3
k. Inspection	3
l. Safety	1

Actually there should be plenty of manpower for the army without tapping industrial brainpower. There are about 16,000,000 between 21 and 35 years of age. The army wants 4,000,000 in five years. About 1,000,000 more young men will reach the age of 21 each year during the life of the act.

Industrialists who are concerned about selective service losses are advised to size up their position as follows: (1) list all employees, (2) eliminate all those over 35 and under 21, (3) eliminate all those who are married or have other dependents, (4) eliminate all those who have physical defects that would bar them from the army, (5) check those among the remaining names that are key men, (6) go to the local board and look up their draft numbers.

Government Training Programs

To provide the difference between supply and demand, recourse must be had to intensive training and the Federal Government has provided three emergency programs as an aid to national defense.

College Grade—$9,000,000 has been appropriated by Congress to the U. S. Office of Education for financing defense training courses in engineering colleges. The courses are intensive—8 to 30 weeks in duration with the average about 300 classroom hours in 12 weeks. Engineering schools on tax-exempt properties and equipped to teach the required courses may participate. Curricula are set by the college and approved by an Advisory Committee on Engineering Training for Defense, which is composed of leading educators (see accompanying list).

As of December 30, 1940, 444 courses had been approved in 91 colleges in 44 States, the District of Columbia and Puerto Rico with a total enrollment of over 30,000 students. Other courses will be established as fast as they can be cleared through the Washington office.

Since the Government pays the bills, no tuition may be charged for the courses; neither may the colleges profit because they must account for expenditures. Twenty-two field representatives of the program (see accompanying list) are stationed in districts from Coast to Coast assigned to contact industry in an effort to establish courses in convenient schools (or at plants if administered by college instructors).

Industry is urged to take the initiative and suggest possible courses in order to expedite the program.

Any engineering subject of college grade intended for immediate application may be taught. Courses established so far in the field of chemistry are listed in the tabulation at the bottom of this page. A more complete though earlier list of courses and the schools participating is given in the tabulation on page 101. Also an outline of a sample curriculum is shown at left.

Day school and night school courses are given. Applicants for study must have certain minimum qualifications set for each course by the college. The college may or may not give credit toward a degree as it chooses. Jobs are not guaranteed to the graduates. However, students completing the courses are eligible for civil service examinations. Also the college will aid in placement. In many cases courses are set up with definite jobs in mind.

Vocational Education—A second training program administered by the U. S. Office of Education is for men of less than college grade. Administered through vocational schools it is designed to finance: (1) pre-employment refresher courses for skilled workers "rusty" in their trades (200-400 hrs.) and (2) up-grading of employed workers (evening courses).

A total of $26,000,000 was appropriated for this phase of the program. The forty-eight States administer, through vocational schools, courses which have been approved by the Commissioner of Education. Of the 14 occupational classifications in use now, two come within the scope of this report—"Chemicals" and "Ammunition." Sixteen vocational schools throughout the country regularly teach industrial chemistry and these may offer the courses mentioned.

By October 31, according to a report dated December 14, 241,428 trainees had received education in 7,645 courses. And 100,567 were still enrolled in 4,421 courses. About 50 percent of the trainees come from WPA rolls. All are selected through

Selected List of Engineering Defense Training Courses for Chemical Men

Course	School	Day or Evening	Weeks	Students (Maximum)
Chemical Courses Approved to December 30, 1940:				
Chemistry in National Defense	Tufts College	Ev.	15	40
Industrial Chemistry	Union College	Ev.	25	65
Chemical Plant Operation	Drexel Institute	Ev.	28	200
Chemical Engineering for Industrial Supervision	University of Pennsylvania	Day	23	125
Chemical Testing and Inspection	North Carolina State College	Day	12	32
Elementary Industrial Chemistry	Carnegie Institute of Technology	Ev.	22	40
Design of Chemical Plant Machinery and Equipment	Ohio State University	Ev.	30	50
Inspection of Materials of Chemical Industry	Ohio State University	Ev.	25	35
Technology of Heavy Chemicals Industry	University of Colorado	Ev	22	20
Testing of Chemicals and Other Defense Materials	University of Denver	Ev.	24	30
Explosives Courses Approved to December 30, 1940:				
Explosives	Ohio State University	Ev.	30	30
Explosives	Case School of Applied Sci.	Ev.	20	60
Explosives Inspection	Purdue University	Day	12	35
Explosives	Kansas State University	Day	12	50

ENGINEERING DEFENSE TRAINING PROGRAM

Courses Approved to December 11, 1940*

Alabama	University of Alabama University	Correlation Course for Ordnance Inspectors Industrial Safety and Safety Administration Mechanics and Strength of Materials Mechanisms and Elementary Machine Design Industrial Organization and Management, Time and Motion Study
Arkansas	University of Arkansas Fayetteville	Engineering Drawing
Colorado	Colorado State College of Agricultural & Mechanical Arts Fort Collins	Machine Design Engineering Drawing Materials Inspection and Testing
	University of Colorado Boulder	Engineering Drawing and Machine Design (4 courses) Technology of Heavy Chemicals Industry
	University of Denver Denver	Testing of Chemicals and Other Defense Materials
Connecticut	Yale University New Haven	Applied Mechanical Design Engineering Drawing Inspection of Materials Production Control
District of Columbia	George Washington University Washington	Construction Materials, Properties, Tests and Specifications
	Howard University, Washington	Engineering Drawing
Illinois	Bradley Polytechnic Institute Peoria	Engineering Drawing
	Illinois Institute of Technology Chicago	Machine Design Testing Methods Inspection Methods Time and Motion Study Industrial Management Drafting and Elementary Design Production Planning, Routing
Indiana	Purdue University Lafayette	Production Engineering (2 courses) Production Supervision (2 courses) Engineering Drafting Materials Inspection Machine Design Materials Testing and Inspection (2 courses) Explosives Inspection
	Rose Polytechnic Institute Terre Haute	Materials Inspection and Testing Engineering Drawing and Machine Design
	University of Notre Dame South Bend	Chemical Analysis of Metallurgical Materials
Iowa	Iowa State College, Ames	Materials Inspection and Testing
Kansas	Kansas State College Manhattan	Engineering Drawing Explosives
	University of Kansas Lawrence	Engineering Drawing Machine Design Materials Inspection and Testing Production Engineering and Supervision
Louisiana	Louisiana Polytechnic Institute Ruston	Engineering Drawing
	Southwestern Louisiana Institute Lafayette	Engineering Drawing
Maryland	Johns Hopkins University Baltimore	Plastics Materials Inspection and Testing
Massachusetts	Harvard University, Cambridge	Engineering Drawing
	Massachusetts Institute of Technology, Cambridge	Ordnance Inspection Engineering Fundamentals
	Northeastern University Boston	Machine Design Materials Inspection and Testing Production Engineering and Supervision
	Tufts College Medford	Chemistry in National Defense Machine Design
Michigan	Michigan College of Mining and Technology Houghton	Machine Design Materials Inspection and Testing Engineering Drawing
	University of Detroit Detroit	Materials Inspection and Testing Drawing, Descriptive Geometry, and Shop Mathematics Production Supervision Production Engineering
	University of Michigan Ann Arbor	Production Engineering and Supervision Machine Design Materials Inspection and Testing
Mississippi	Mississippi State College State College	Engineering Drawing Materials Inspection and Testing
New Hampshire	University of New Hampshire Durham	Engineering Drawing
New Jersey	Newark College of Engineering Newark	Machine Design Engineering Drawing Materials Inspection and Testing
	Rutgers University, New Brunswick	Machine Design
	Stevens Institute of Technology Hoboken	Introduction to Engineering Elements of Engineering Drawing
New Mexico	New Mexico College of Agricultural and Mechanical Arts State College	Engineering Drawing Materials Inspection and Testing Machine Design
New York	New York University New York City	Time and Operation Study Gaging and Inspection Methods Production Control
	Union College Schenectady	Chemistry of Metals Drafting and Drafting Room Practice Elementary Mechanics and Strength of Materials Engineering Materials and Manufacturing Methods Industrial Chemistry Production and Cost Control
North Carolina	Agricultural and Technical College of North Carolina, Greensboro	Materials Inspection and Testing
	Duke University, Durham	Machine Design
	North Carolina State College Raleigh	Production Engineering Machine Design Materials Inspection and Testing Chemical Testing and Inspection
North Dakota	University of North Dakota University	Engineering Drawing Materials Inspection and Testing
Oklahoma	Oklahoma Agricultural and Mechanical College Stillwater	Production Engineering Machine Design Materials Inspection and Testing Engineering Drawing
	University of Oklahoma Norman	Engineering Drawing (2 courses)
Ohio	Case School of Applied Science Cleveland	Explosives Elements of Motion Economy Fundamentals of Machine Design Inspector and Metallurgical Technician
	University of Cincinnati Cincinnati	Materials Inspection and Testing Production Supervisor
Pennsylvania	Bucknell University Lewisburg	Engineering Drawing Materials Inspection and Testing
	Carnegie Institute of Technology Pittsburgh	Engineering Drafting (2 courses) Production Engineering Elements of Metallurgical Engineering Testing and Inspection Machine Design Production Supervision
	Drexel Institute of Technology Philadelphia	Production and Tool Engineering Machine Design Chemical Plant Operation
	Grove City College, Grove City	Engineering Drawing
	Pennsylvania State College State College	Fuel Technology Pyrometry Physical Testing of Materials (2 courses) Elementary Engineering Drafting Elementary Machine Design Operation Inspection Petroleum Refinery Control Pre-Foremanship Training in Production Supervision Production Engineering (2 courses) Time and Motion Study
Tennessee	Vanderbilt University Nashville	Engineering Drawing Machine Design Materials Inspection and Testing
Texas	Southern Methodist University Dallas	Engineering Drawing Production Supervision
	Texas College of Arts and Industries, Kingsville	Engineering Drawing
	University of Texas Austin	Engineering Drawing Materials Inspection and Testing (2 courses)
Utah	University of Utah Salt Lake City	Materials Inspection and Testing Mechanical Drawing and Descriptive Geometry Machine Design
Vermont	Norwich University, Northfield	Engineering Drawing
Virginia	University of Virginia Charlottesville	Engineering Drawing
Washington	State College of Washington Pullman	Engineering Drawing
West Virginia	West Virginia University Morgantown	Process Engineering (Chemical) Testing and Inspection Production Supervisors Drafting and Designing
Wisconsin	Marquette University, Milwaukee	Materials Inspection and Testing Production Engineering
Wyoming	University of Wyoming, Laramie	Engineering Drawing

*Courses listed here are only those applicable in chemical industries. Other courses have been approved. Also additional chemical courses were approved too late for publication.

State employment agencies. Special representatives confer with industrial managers to encourage training of foremen and supervisors.

Training Within Industry—A third training program is being carried out by the labor division of the Advisory Commission to the Council of National Defense. It has no financing appropriation and is designed as a service to help industry help itself. The program is staffed with experts "borrowed" from industry. It is their intention to render specific *advisory assistance* to defense industries in inaugurating training programs to be carried on by individual companies within their own plants at their own expense.

Localized to 22 districts, the organization works through field service agents who give experienced advice without charge *upon request*. From time to time, the Washington headquarters issues mimeographed bulletins such as the following:

Bul. No.	Title
1	The "Training Within Industry" Program
2	Upgrading Within Industry
2A	Expediting Production Through Training
2B	How to Prepare Instructors to Give Intensive Job Instruction
3	Expediting the Training of Skilled Tradesmen
4	Strengthening the Managerial Organization
4A	Expanding the Managerial Organization
4B	Improving Supervisory Practice

These bulletins are available from the office of C. R. Dooley, Training Within Industry Program, Room 3207, North Interior Bldg., Washington, D. C. A more detailed discussion of the plan, written by Mr. Dooley, was published in *Chem. & Met.* November 1940, p. 764.

Reprints of this 8-page report are available at 25 cents per copy. Address the Editorial Department, Chem. & Met. 330 W. 42nd St., New York, N. Y.

WORKING CONDITIONS

Biggest fly in the ointment as far as working conditions at the new plants are concerned is the problem of housing. Most of the munitions plants are located a long way from cities. Therefore, employees must commute many miles or houses must be built. Congress enacted the Lanham Act appropriating $150,000,000 to be spent through the Federal Works Administrator on temporary homes for the low income workers. Operating companies may build homes for their executives. But the technical man is betwixt and between; so his problem is a more serious one.

There is an RFC subsidiary called Defense Homes Corp. which has $10,000,000 with which to build self-liquidating projects under FHA loans. That means the corporation can build $50,000,000 worth of homes of a more or less permanent nature. It is hoped that these may be developed as suburbs of big cities. Efforts will also be made to interest private builders in putting up permanent homes near the plants. As a matter of fact, it is hoped that most of the housing may be provided in this way.

APPLYING FOR A JOB

Practically all the chemical companies holding War Department contracts are accepting applications now for jobs available in the Spring and early Summer, as well as for jobs available immediately. In the Atlas Powder Co. application should be made to the plant managers. Mr. Alf Erickson will manage the Weldon Springs, Mo., TNT plant; and Mr. W. E. Fletcher will manage the Ravenna, Ohio, loading plant. Both are now located in Wilmington, Del. Application to E. I. duPont de Nemours & Co. should be made to the Personnel Division, Wilmington, Del. At Hercules Powder Co., also in Wilmington, Joseph McVey handles chemical engineers' applications. For jobs in Solvay's new ammonia plant, address E. W. Bowen, Nitrogen Div., Solvay Process Co., Hopewell, Va. (P. O. Box 61).

Information and applications for any Civil Service job may be obtained from any first or second class post office. All persons desiring to register in the Roster of Scientific and Specialized Personnel should write to that agency in Washington, D. C. for a questionnaire, stating their respective fields of proficiency.

More than $45,000,000 of the Government's 300-odd million for new chemical munitions plants is being spent here in Wilmington, Ill. It will bring an influx of more than 10,000 workers when the plants are finished—even more during the final stages of construction. Housing in such small towns is a big problem being tackled by Defense Homes Corp., RFC subsidiary

Machinery, Materials and Products

Chem & Met Process Equipment NEWS

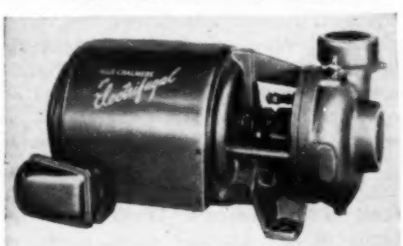
Close-Coupled Pump

ELECTRIFUGAL is the name given to a new line of close-coupled centrifugal pumps recently announced by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The new pumping unit is specially designed throughout for the type of service encountered, employing a special motor with a one-piece cast iron motor yoke and pump bracket, with the feet cast integral with the housing and bracket, extending under the entire unit instead of under the motor only. Splash-proof motors are standard, with totally-inclosed, fan-cooled motors and explosion-proof motors available if desired. In the splash-proof type, this pump is made in sizes from 1 to 10 hp. for heads up to 160 ft., with larger sizes in process of design. For normal service, the pump is built with cast iron housing and bronze fittings. It can be made in all-iron or all-bronze construction, or in other special metals as needed. For higher heads, two-stage units are available up to the limit of the Electrifugal motor design.

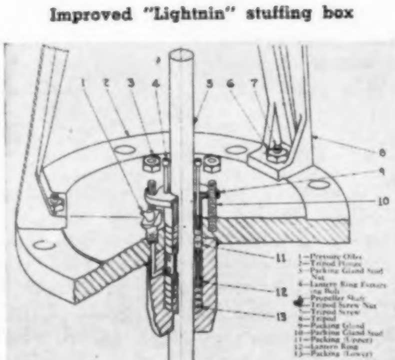
Improved Stuffing Box

To SIMPLIFY maintenance of the stuffing box employed in its Tripod type mixer construction, the Mixing Equipment Co., Rochester, N. Y., has introduced a new built-in lantern-ring puller. The novel feature will be clear from the accompanying drawing. Once the upper packing is removed, the puller bolts shown installed in the packing gland, are threaded into the lantern ring. Compressor nuts are then used below the compressor ears to pull out the entire assembly. Special tools are not required and "fishing" for difficult-to-remove lantern rings is completely eliminated. Possible damage to the ring or shaft is thus done away with and greater likelihood of proper repacking results.

Close-coupled centrifugal pump



Improved "Lightnin" stuffing box



Compact Lift Truck

FOR 1,000- to 3,000-lb. loads the Towmotor Co., 1226 East 152d St., Cleveland, Ohio, has developed the new Model LT-40 lift truck, built on a 40-in. wheelbase. The new truck has an overall length without forks of 70 in., a width of 35 in. and a turning radius of 68 in. It is powered by a 22 hp. gasoline engine and travels at speeds from 1 to 10 m.p.h. with two speeds forward and two in reverse. The manufacturer claims the unit will lift and stack its rated load accurately to heights of 7, 9 and 11 ft. at the rate of approximately 40 ft. per min. Various interchangeable attachments such as forks, rams, scoops, flat plates and special loading devices are available for these units.

Automatic Molding Press

RECENTLY developed by the Cropp Engineering Div. of Warren Lamp Co., Warren, Pa., a new completely automatic molding press of 12 tons capacity has been announced for use in the molding of phenol and urea-formaldehyde, and phenol-furfural, molding powders. The new press is designed for use with single or double-cavity molds costing perhaps only 10 per cent as much as a hand-operated multiple mold, yet, according to the manufacturer, producing as much as the latter. Compared with hand operated equipment, it is claimed to save as much as 50 per cent of the flash losses. The press is completely self-contained, requiring only an electrical connection and an air source of about 100 lb. pressure.

The press is designed for a maximum projected area of molded piece of 13 sq.in. Electrically operated and controlled in each of its eight automatic functions of the complete cycle, its power consumption is stated to be less than 35 kw.-hr. per 24-hour day.

Low-priced lift truck

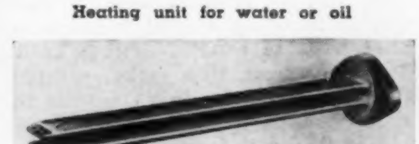
Combination Steam Trap

FOR HANDLING large quantities of condensate at pressures up to 175 lb., Sarco Co., 183 Madison Ave., New York, N. Y., has developed an indirect steam trap consisting of a standard Sarco inverted bucket trap of small size, coupled to a special diaphragm valve in the condensate discharge line. The valve is normally closed. As condensate collects in the discharge line, some of it flows into the pilot trap which opens when sufficient condensate has collected. Discharge from the pilot trap is piped to the large diaphragm of the main valve and when pressure reaches this diaphragm, the valve opens wide. It is held open as long as condensate flows, but shuts tightly as soon as the trap closes. Since the main valve is available in sizes from ½ to 2½ in. inclusive, extremely large volumes of condensate can be handled. The new arrangement is known as Type BSDE.

Immersion Heaters

SEVERAL NEW TYPES of immersion heaters have recently been announced by Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh, Pa. The new Chromalox type MF heater, illustrated herewith, has been designed for water and oil heating in capacities from 750 to 5,000 watts, inclusive. This unit presents a large rectangular heating surface which is sheathed in copper for water heating, or in steel

Heating unit for water or oil



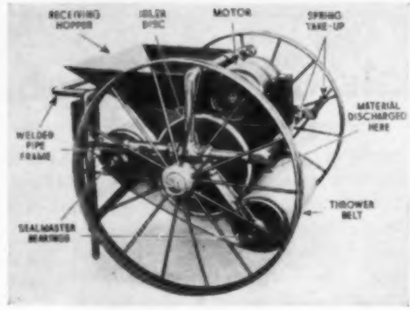
for oil heating. The company has also developed a complete line of tubular heating units in diameters from $\frac{3}{16}$ to $\frac{1}{2}$ in. inclusive, and in lengths from 12 in. to 8 ft. These units are designed for use in water, oil, air, molten metals and molten salts and are constructed with a helical coil of nickel chromium resistance wire, imbedded in a refractory material, which is encased in a metal tube. Copper, steel and special high temperature alloy tubes for operating at temperatures up to 1,200 deg. F. are used, depending on operating conditions. These tubular units may be bent to any desired shape by the manufacturer to fit the desired application.

Central Lubrication System

For use in the lubrication of smaller machinery than that for which its standard Dualine system is intended, the Farval Corp., 3255 East 80th St., Cleveland, Ohio, has developed the Dualine, Jr., centralized system of lubrication, operating on the same principle as the larger type, but employing valves, pumping units, fittings and lines of greatly reduced size. The system comprises a central pumping unit connected by two supply lines to a group of valves which discharge to the individual bearings. The valve blocks are connected in parallel across these two lubricant supply lines. The system is operated by applying pressure alternately to each of the two supply lines, this operation causing a measured amount of lubricant to be discharged from the valve at each reciprocation. Either oil or grease may be used. The valves, which are available in manifolds of two, four, six and eight outlets per valve block, are adjustable in capacity from a minimum of 0.0012 fluid oz. to a maximum of 0.0094 fluid oz. for each valve operation. The new system, according to the manufacturer, reduces oiling labor, eliminates lubricant wastes, prolongs equipment life and insures correct lubrication independently of the judgment of the oiler or his ability to reach all bearings regularly.

Moistureproof Timer

For numerous applications in which timers may be subjected to excessive moisture and dust conditions, the R. W. Cramer Co., Centerbrook, Conn., has developed the Model D2 interval timer, which is inclosed in a specially built dust-tight and splash-proof cast aluminum housing arranged for conduit connection. The timer is operated by a standard self-starting synchronous-motor-driven clock and is provided with a time dial protected by a window and supplied with an external setting knob. Twelve different time scales, ranging from one revolution in 15 seconds to one revolution in 24 hours are available. A slight inward pressure on the knob assembly engages a clutch for setting the timer. When released, a spring and gasket prevents entrance of moisture around the control shaft.



Redesigned loader and piler

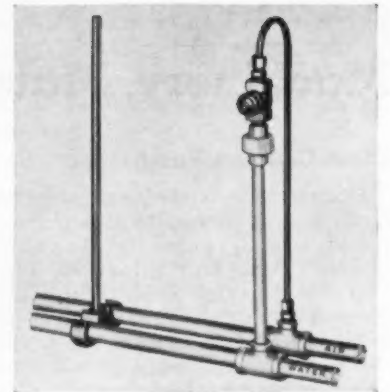
Moistureproof electric timer

Improved Loader

Several design improvements have been made in the new model loader and piler recently introduced by Stephens-Adamson Mfg. Co., Aurora, Ill. These loaders are now equipped with this company's permanently sealed self-aligning, pre-lubricated ball-bearing units. New simplified means have been developed for aligning the fast-moving belt which throws the material. Alignment is now accomplished by moving one end of the forward pulley backward or forward by means of a screw control. Among other improvements may be mentioned the simplifying and refining of the welded pipe frame.

Spray Nozzles

Several new types of spray nozzles have recently been announced by Spraying Systems Co., 4023 West Lake St., Chicago, Ill. A new spray-drying nozzle made in either tin-plated iron or stainless steel, with or without a removable cap, comes in orifice sizes varying from 0.0135 to 0.038 in., for operating pressures from 1,000 to 5,000 lb. Such nozzles produce a highly atomized cone spray. The company's new humidifying nozzle, shown in the accompanying illustration, employs compressed air controlled by a solenoid-operated valve, actuated by a humidistat, to atomize water without possibility of drip during shut-off intervals. When the aspirating effect of the flowing air ceases, the water drops back to the controlled level in the standpipe. A third new nozzle is an atomizing type for spraying 1.2 to 17 gal. per hr. at 60 lb. pressure. This type is made of brass with stainless steel inserts for orifice and cored tip, and a Monel metal strainer. All-stainless-steel construction can be employed if desired.



Humidifying nozzle

Water Treatment Equipment

A recent announcement from Worthington Pump & Machinery Corp., Harrison, N. J., describes this company's entrance into the field of water softening and purification. The company is now prepared to provide pressure sand filters for water purification as well as hot process water softeners for feedwater treatment. Several novel features are found in the softener. Water brought in at the top is introduced into the reaction-settling chamber in the form of a cone beneath which steam is admitted. This method is said to eliminate deposition of solids on the softener surfaces. The chemical is then added and the water passes slowly downward, reversing its flow in leaving the softener. Solids continue downward and deposit in the cone bottom. What is in effect a separate tank for the filter wash water is an annular space between the reaction-settling chamber and the outer shell of the softener. Wash water returns to this annular space near the bottom so as to facilitate settling of the solids removed from the filter. For feedwater treatment the filter bed is composed of a special hard, granular carbon, rather than sand, to avoid possibility of dissolving silica.

New Products

A product useful for sealing the tops of bottles containing materials employing alcohol as a solvent has been announced under the name of Cover-Seal by the Varnitron Co., 4865 West 21st St., Los Angeles, Calif. This compound is resistant to both ethyl and isopropyl alcohols. The

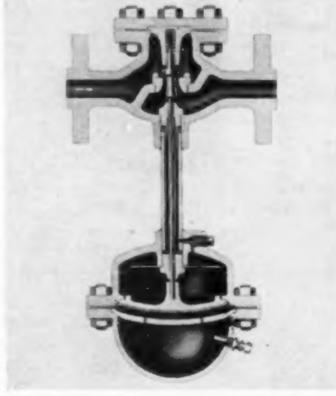
material is applied by warming and dipping the bottle top into the warm mixture, allowing the top to cool for about one minute. Cover-Seal is available in various colors, can be applied in machine closure operations, is not brittle, is non-drying, and resistant to abrasion, according to the manufacturer.

CLEANING of soft metals such as aluminum, tin and certain alloys, from which animal, vegetable or mineral oils as well as solid dirt must be removed, can be accomplished without etching, according to the manufacturer, with a new alkaline silicate cleaner known as Metso 88 Special. This material, offered by the Philadelphia Quartz Co., 121 South 3d St., Philadelphia, Pa., is supplied in concentrated liquid form, requiring only dilution before use. It is completely soluble, thus eliminating any danger of cleaning material settling to the bottom of the tank.

INSIDE DIAMETERS, ranging from ⅛ to ½ in., with wall thicknesses from $\frac{1}{16}$ to ⅛ in., are available in a new line of Koroseal tubing announced by The B. F. Goodrich Co., Akron, Ohio. This plasticized polyvinyl chloride synthetic material has rubber-like qualities and is extruded in tubing without fabric or other wall reinforcements. Sizes up to 3 in. O. D. can be made to special order. The new hose is designed for working pressures up to 50 lb., at temperatures to 120 deg. F. It is resistant to oil and most rubber solvents, is practically impermeable to gas diffusion and does not absorb moisture, according to the manufacturer. In a typical application on electrolytic cells, no deterioration from the electrolyte was reported after 30 months' service, although the best rubber used previously had failed after six months owing to oxidation by sulphuric acid.

LOWERING of the firing temperature from the customary 1,600 deg. F. to 1,400 deg. F. is the accomplishment of Pyroflex, a new inorganic porcelain-enamel finish developed by the Porcelain Enamel & Mfg. Co., Baltimore, Md. The new finish can be applied in only one coat to lighter gage enameling stocks and in some cases to black iron, according to the maker. No special metal bonding treatment is necessary.

Air-dome-loaded reducing regulator



AS A SUBSTITUTE for toluol, which may become scarce through defense requirements, the Neville Co., Neville Island, Pittsburgh, Pa., has introduced Notol, a low-cost replacer for industrial toluol. This water-white material has a specific gravity of 0.800, an initial boiling point of 72 deg. C. and is characterized by a high nitrocellulose dilution ratio, comparing favorably with toluol.

Pressure Reducing Valve

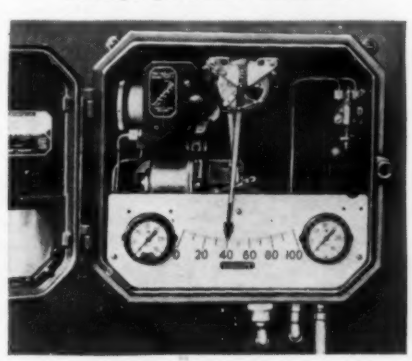
PRESSURE REDUCTION of steam, hot liquids and hot gases, for initial pressures up to 2,500 lb. per sq.in., delivery pressures to 1,200 lb. and temperatures to 1,000 deg. F., is the function of a new line of air-dome-loaded pressure reducing regulators made in both single- and double-seated designs by the Foster Engineering Co., 109 Monroe St., Newark, N. J. Both designs are produced in 150 lb., 300 lb., 400 lb., 600 lb., 900 lb., 1,500 lb. and 2,500 lb. standard types. Depending on the operating pressure, valve sizes range from ½ to 4 in., with 2 in. as the limit for the higher pressure types.

In these regulators, springs and weights are eliminated and loading of the valve is accomplished by air pressure against one side of a diaphragm, with the reduced pressure balanced against the other side. Lowering of the reduced pressure owing to increasing demand causes opening of the valve, thus increasing the reduced pressure to regain the balance. Increasing of the reduced pressure produces the converse effect. The valve may be loaded by hand pump, either at the valve or remotely, or it may be loaded automatically from a distant location through a dome-loader pilot valve containing an adjustable bleed.

These regulators can be set for reduced pressures from 5 lb. up to the initial pressure. The double-seated type is used for continuous load, and the single-seated type for dead end service. Extreme accuracy is said to be attained through elimination of friction and the hysterisis inherent in springs. Owing to the use of few moving parts, maintenance is said to be minimized.

New Tufflite concentrator

Fulscope pneumatic transmitter



Floodlighting Unit

TO MEET the need for a local floodlighting unit able to withstand severe vibration and the effect of corrosive atmospheric vapors, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has announced the Tufflite Concentrator, a unit using either a 300 or a 500 watt PF-40 Mazda lamp. The unit consists of a copper housing, inner Alzak aluminum reflector, cast bronze socket housing assembly and swivel for ¾-in. conduit mounting. The unit is sealed with a glass cover door assembly, held securely in place against a graphitized asbestos gasket by eight bronze spring clips fastened with machine screws.

Remote Transmitter

TWO NEW INSTRUMENTS have been announced by Taylor Instrument Cos., Rochester, N. Y. One of these is a remote pneumatic transmission system for indicating, recording or controlling process variables at points remote from the point of measurement. The new system is intended particularly for use where it is desirable to correlate temperature, pressure, flow or liquid level data on a centralized panel or in a control room. The system utilizes this company's standard instruments and may employ one or two transmitters connected to a single receiver or to more than one receiving instrument, as far away as 1,000 ft. from the transmitter. An accuracy well within plus or minus 1 per cent of scale range is claimed. The transmission lag is one second or less per 100 ft. of connecting tubing.

This company's other new device is a process timing mechanism which can be installed on Fulscope recording controllers. A dial calibrated in time units is installed outside the instrument case at its upper right-hand corner. A manually set pointer is set

to the desired process time when the batch is started. The timer does not, however, start to operate until the temperature reaches the set point at which instant the mechanism starts, terminating the process only after the desired period at the control temperature.

Heavy Duty Scale

Two MODELS, one of 100 lb. and one of 150 lb. capacity are available in a new even-balance platform scale recently announced by the Exact Weight Scale Co., 944 West 5th Ave., Columbus, Ohio. The scale, including the lever system, is built of a light-weight aluminum alloy so as to be readily portable, weighing only 130 lb. The dial, inclined at 30 deg., is 44 in. from the floor and may be turned in any direction to suit the convenience of the operator. Weighings are made against full capacity cast iron weights which are placed in the weight box. Scale oscillation is controlled by an oil dash-pot. The dial indicates 16 oz. over and under, with ½ in. indicator travel for each ounce. Visible sensitivity is stated to be ¼ oz.

Direct-Reading Manometer

USE OF A novel sliding scale in a direct-reading U-tube manometer has been announced by Trimount Instrument Co., 332 South La Salle St., Chicago, Ill. The scale is an endless, flexible steel ribbon operating on two pulleys, on which the divisions in inches and tenths appear in white on a jet black background. In use the zero point of the scale is moved up or down to the level of liquid in the lower leg of the manometer, whereupon the level of the upper leg is immediately read in inches differential between the pressures in the two legs. Standard instruments are available in lengths up to 36 in., with high pressure instruments, totally inclosed for operating up to 700 lb. pressure, in lengths up to 100 inches.

Temperature Controls

Two NEW temperature controls have been announced by Barber-Colman Co., Rockford, Ill. The new remote bulb Microtherm is illustrated herewith. This remote bulb thermostat is used where a motor-operated valve or damper must be positioned accurately and quickly in accordance with load variations. The hydraulically formed bulb and bellows assembly are liquid filled and designed with liquid volume and conducting surfaces balanced to minimize ambient temperature effect. Thermostats with two-position control and for floating control are also available.

The second development of this company, known as the remote bulb Econostat, is a new instrument designed to control building heating in relation to outside temperature. It maintains the desired indoor temperature by varying the "heat on" periods in accordance with outdoor temperature changes. Thus the heat supplied is in proportion to the heat loss from the building and is not dependent upon the temperature in any particular room. The equipment includes an outside bulb connected to a control cabinet within the building, in which is a cycler mechanism which periodically closes a circuit controlling the "on" period of the heating plant. The length of time that the circuit is closed is governed by a bellows-operated mechanism connected to the capillary tube and outside remote bulb.

Equipment Briefs

FOR USE on hydraulic plungers ranging in diameter from 9 to 90 in. Wayne Davies Packings, Inc., 325 West Huron St., Chicago, Ill., has introduced a new reinforced hydraulic U packing designated as the "Double U" because the wear wall and heel are doubly reinforced against wear. The usual reinforcement is chrome-tanned leather of belting grade, backed by an oak-tanned belting leather strip. A patented phosphor bronze spring spacer maintains light pressure against the inside of the contact lip to insure a primary seal.

A RESPIRATOR so small that it can be carried in the vest pocket has been perfected by H. S. Cover, South Bend, Ind. Covering only the nose, the new respirator is claimed to be suitable for protection against nuisance dusts. Despite its small size, the filter is so folded as to give 9 sq. in. of filtration area. Filters are easily changed. The respirator weighs only 1 ounce.

DEVELOPMENT of a new pH test set for refrigerant brine testing has been announced by the York Ice Machinery Corp., York, Pa. The set utilizes the colorimetric method with a universal indicator, having 11 color standards covering a range from 5 to 10 pH in ½-pH increments. All parts are held in a wood carrying case, the set comprising fade-resisting color standards, a funnel and filter paper, a small comparator block, a thermometer, glass cylinder and hydrometer.

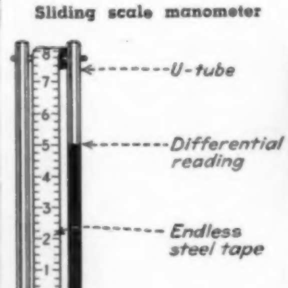
SEVERAL new developments have recently been announced by Proportioneers, Inc., 9 Codding St., Providence, R. I. One of these is the use of transparent plastics for the molding of the liquid ends of this company's Chlor-O-Feeder proportioning pumps, to permit inspection of the pumping action during operation. These transparent liquid ends will henceforth be employed on all such models without extra cost. Another development of the company is a low-cost feeder for hypo-chlorination and other chemical feeding services, so simplified that it may be installed and serviced by the user. This model, known as the Du-Self, is intended for small-sized water treating plants.

AN IMPORTANT development announced by the Hancock Valve Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn., is the use of Superfinishing for the valve seats and disks on this company's "500 Brinell" valves. This operation, borrowed from the automotive industry where it was developed by Chrysler, is said to have the surprising effect of increasing the life of seat and disk twelvefold. The new finish is produced by a honing method which yields a highly polished wearing surface, so fine as to eliminate almost the last trace of friction, according to the manufacturer.

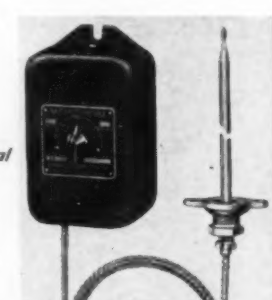
A LIGHT-WEIGHT RESPIRATOR, known as the Willson Bantam has been introduced by Willson Products, Inc., Reading, Pa. Described as the lightest weight throw-away-filter type respirator yet to receive U. S. Bureau of Mines approval, the new device is said to afford protection against silicosis-producing dusts, nuisance dusts and mists, and chromic acid mists. The respirator is claimed to be so light in weight and so easy to breathe through that it can be worn for long periods of time without noticeable discomfort to the worker.

Even balance platform scale

Sliding scale manometer



Microtherm controller



Flash Drying of Sludge

SEWAGE TREATMENT in a community the size of Chicago requires continuous handling of large quantities of industrial and domestic waste matter in such a way as to effect complete disposal without nuisance. Such an operation is conducted at the four treatment works of the Sanitary District of Chicago which now have installed capacity to treat a daily average flow of 1,258,000,000 gal. Capacity of the Southwest Works shown here is 400,000,000 gal.

The activated sludge process is used as shown in the cross section. Action of the biological organisms in the sludge which is mixed with the sewage as a culture extracts dissolved organic materials from the water. When the sludge is settled out a clear, inoffensive effluent is discharged.

Disposal of the organic matter removed from the sewage without creating serious odor nuisances is a difficult operation. The new flash-drying system developed by the District is shown in the flow diagram. In this process the liquid sludge is first coagulated with ferric chloride and then partially dewatered on vacuum filters. The wet filter cake is mixed with dried sludge to present the maximum surface area per unit volume of solids for drying in suspension in a stream of sludge vapor at atmospheric pressure and high temperature. Dried sludge is removed from the superheated drying vapor and either burned like powdered coal or sold for fertilizer.

The fundamental principles of this system are the drying of the material in very small particles in a medium having high specific heat and therefore large capacity to absorb moisture, and the destruction of all odors by passing waste vapors through temperatures higher than 1,200 deg. F. in the furnaces. When burned the sludge will generate enough heat to dry itself without added fuel but when the sludge is diverted for fertilizer the heat for drying is supplied by coal. The drying operation is here combined with generation of steam for operation of the plant.

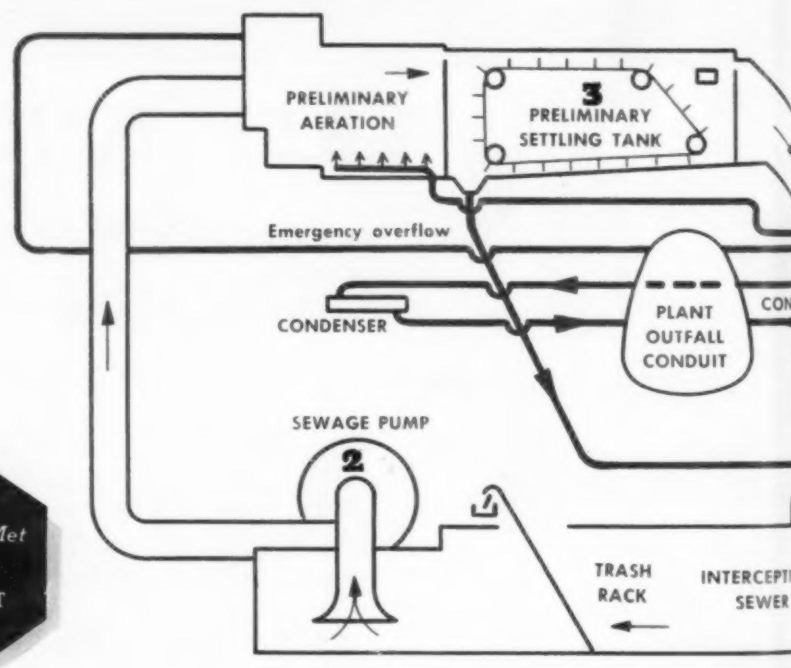
CHEMICAL & METALLURGICAL ENGINEERING

January, 1941

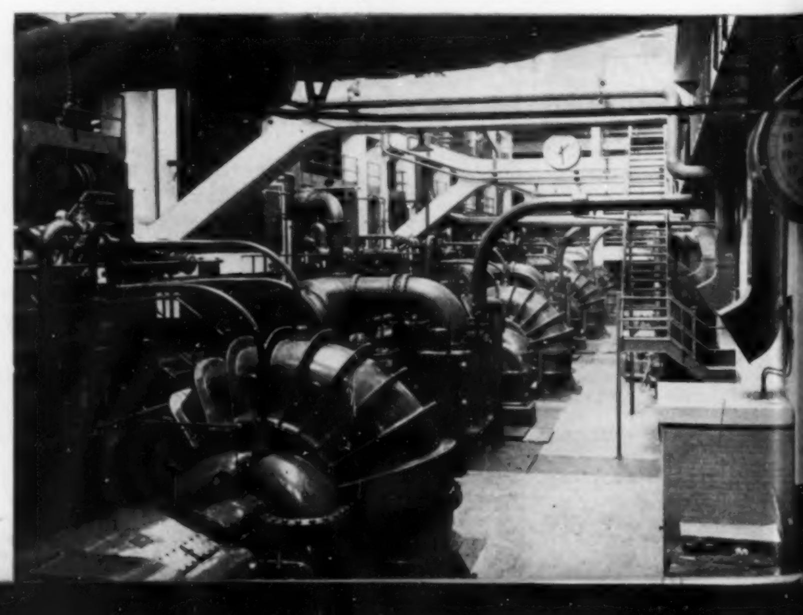
PAGES 108-111

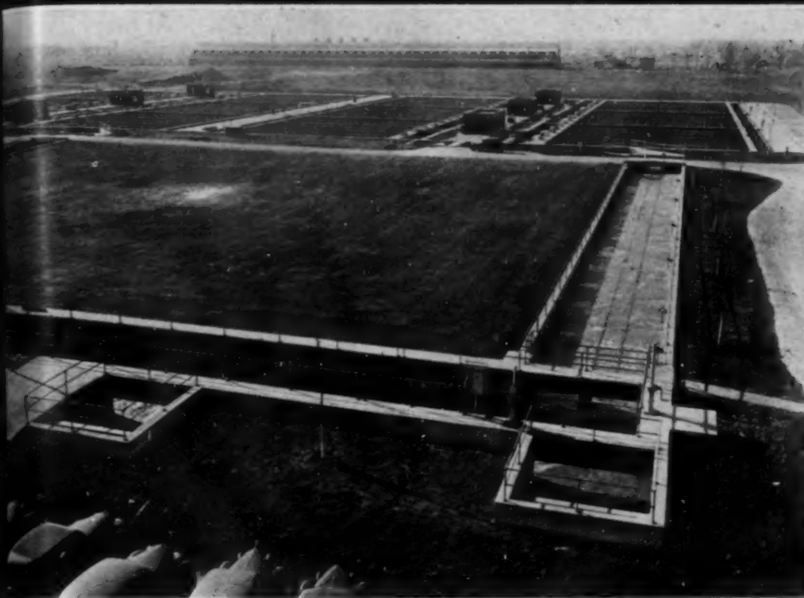
A
Chem & Met
FLOW
SHEET

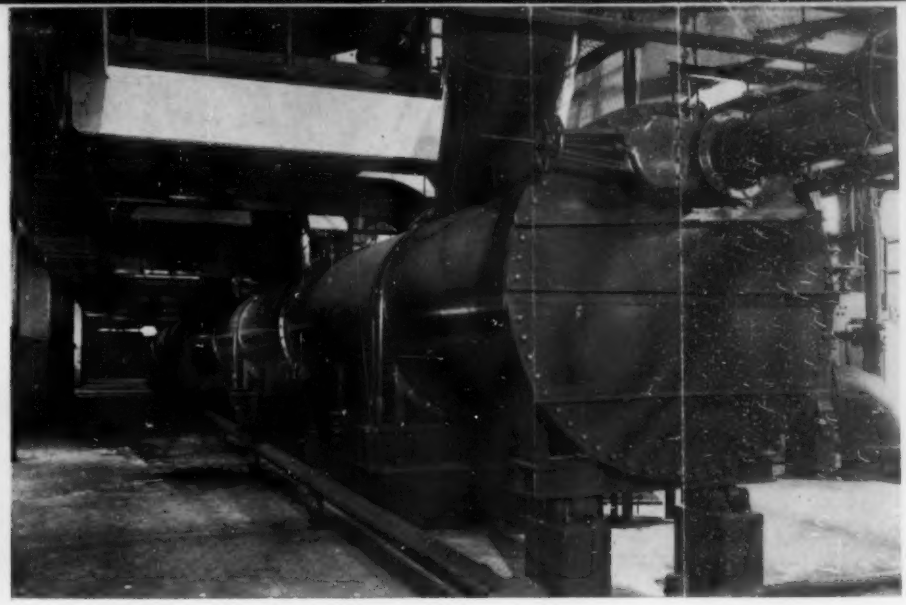
1 Pump and blower house, steam generating plant and sludge disposal building. Coal and ash handling plant is at the right



2 Four 300-cu.ft. per sec. centrifugal pumps driven by 2,100-hp. steam turbines with reduction gears lift sewage to treatment tanks





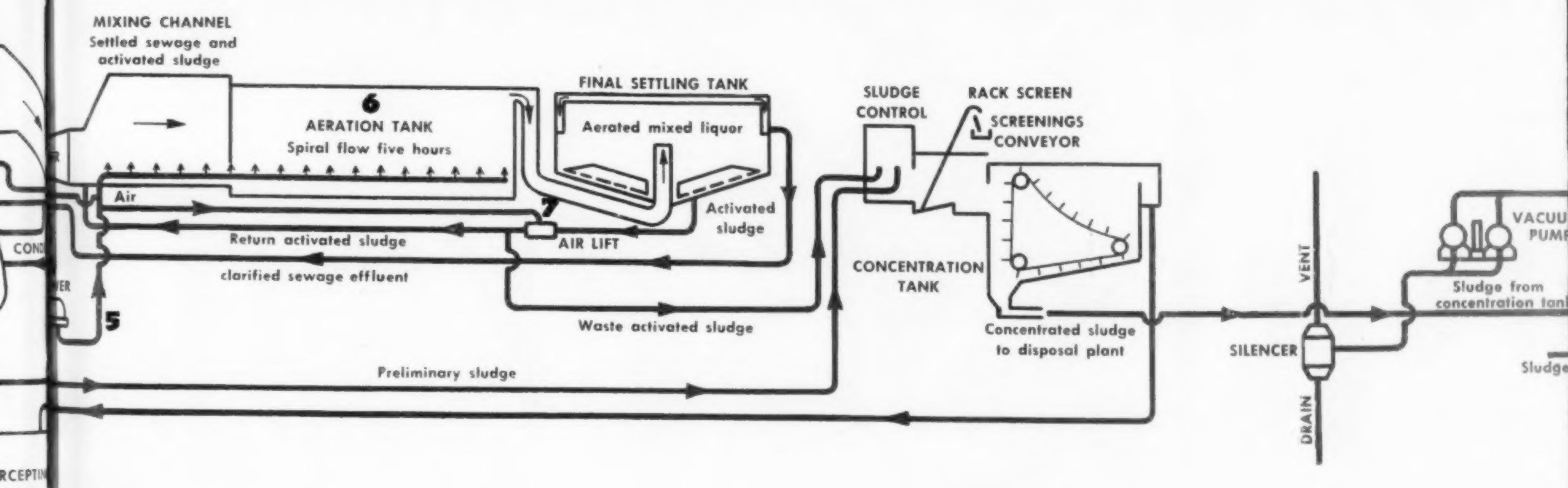


osal b

Aerated channels convey raw sewage to preliminary settling tanks where n and settleable solids are removed

5 An 84-in. welded steel air main carries compressed air from the blowers to the treatment process at 8 lb. pressure

7 lifts

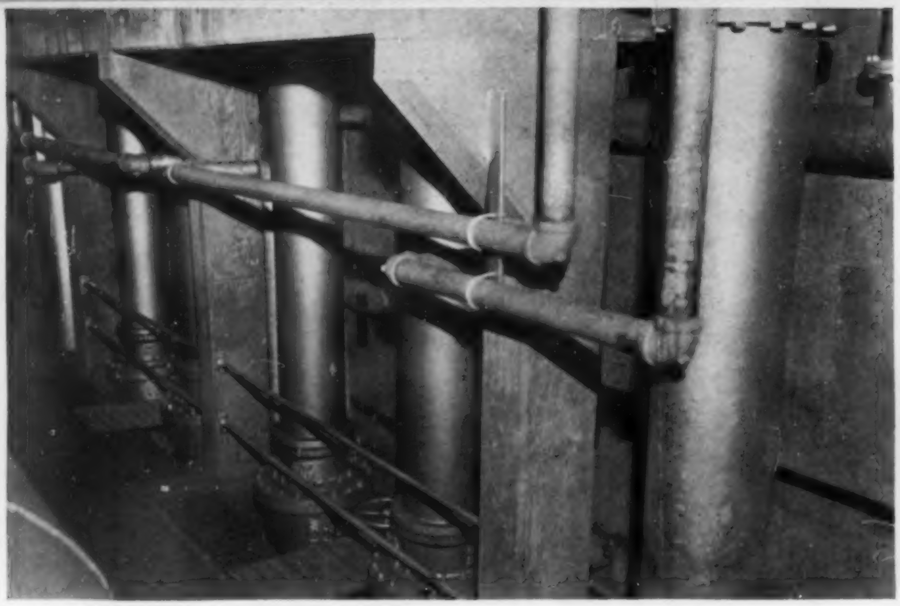


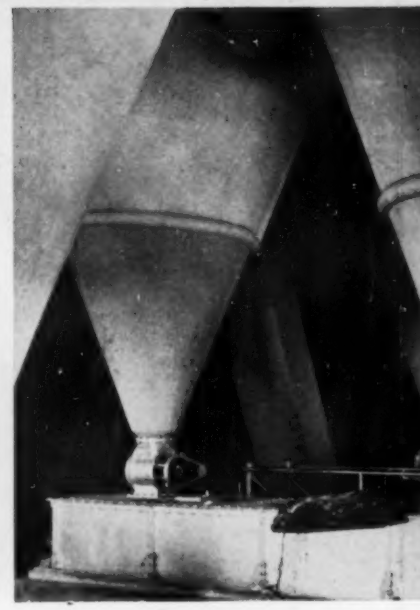
eam t

Three 70,000-cu.ft. per min. Turbo blowers in foreground and two 5,000 ., 6,600-volt Turbo generators for operating auxiliary equipment

6 General view of aeration tanks (center) and final settling tanks (foreground) showing sludge removal mechanisms at the Chicago treatment works

8 80

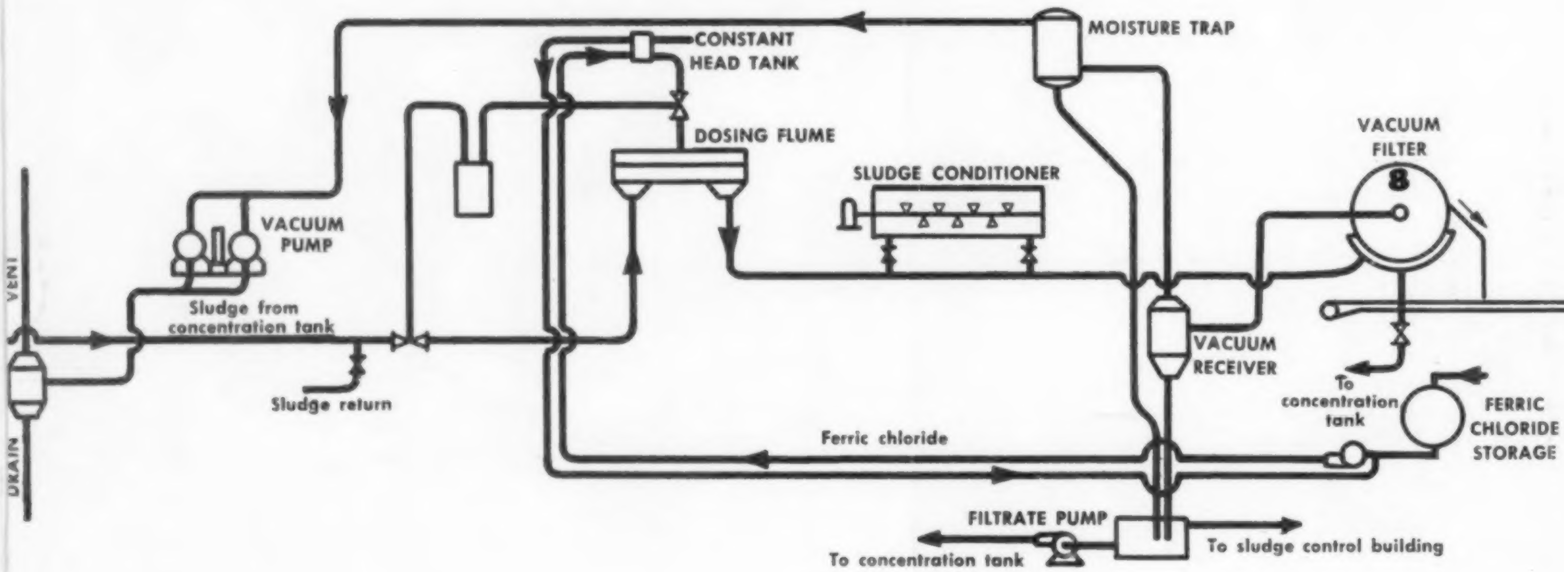




the blowers to the

7 Air lifts are used instead of pumps for the handling of sludge. These 18-in. lifts are handling activated sludge from the final settling tanks

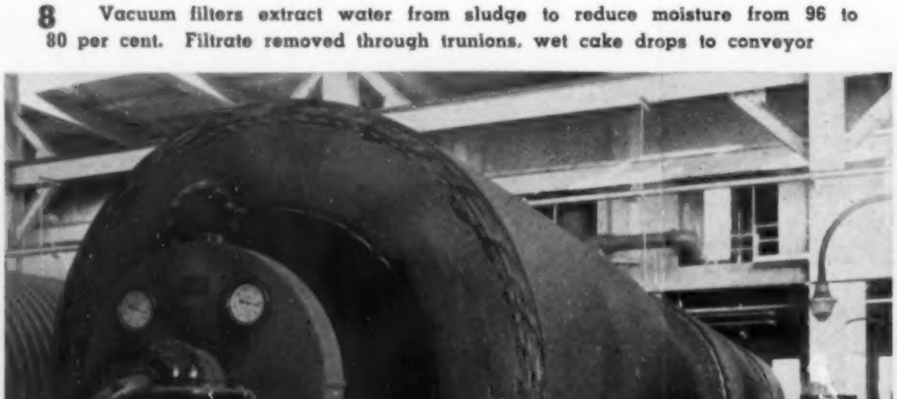
9 Dried sludge is removed from the
in the accompanying illustration

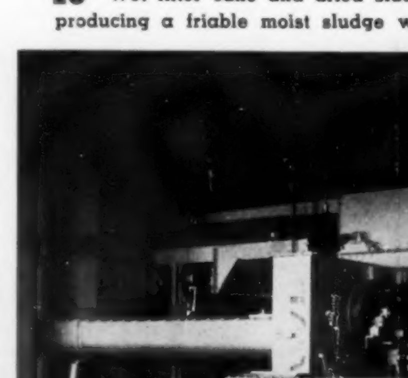


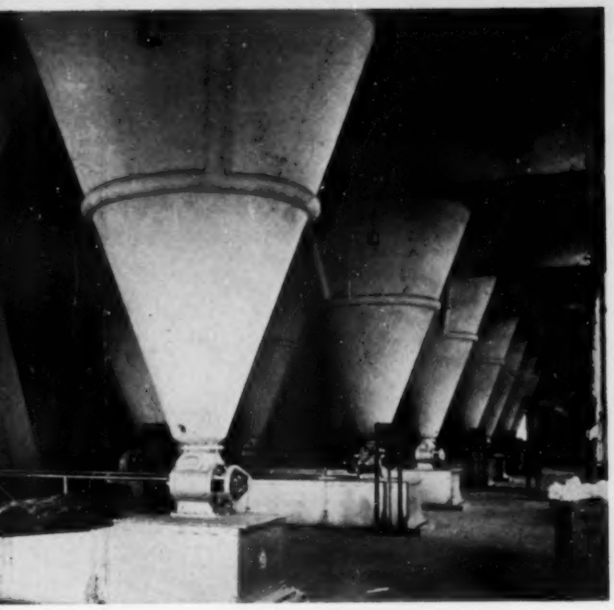
tanks (foreground)
it works

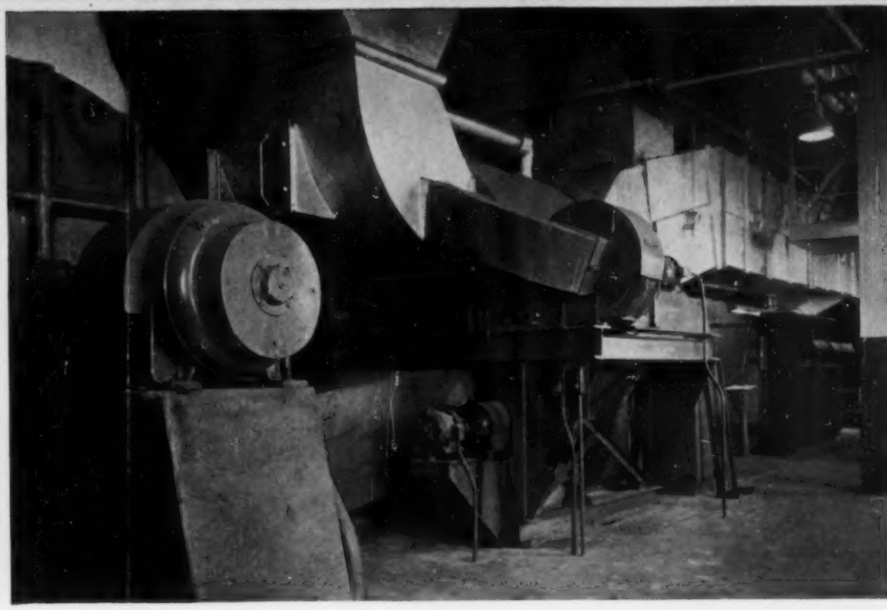
8 Vacuum filters extract water from sludge to reduce moisture from 96 to 80 per cent. Filtrate removed through trunions, wet cake drops to conveyor

10 Wet filter cake and dried sludg
producing a friable moist sludge wh



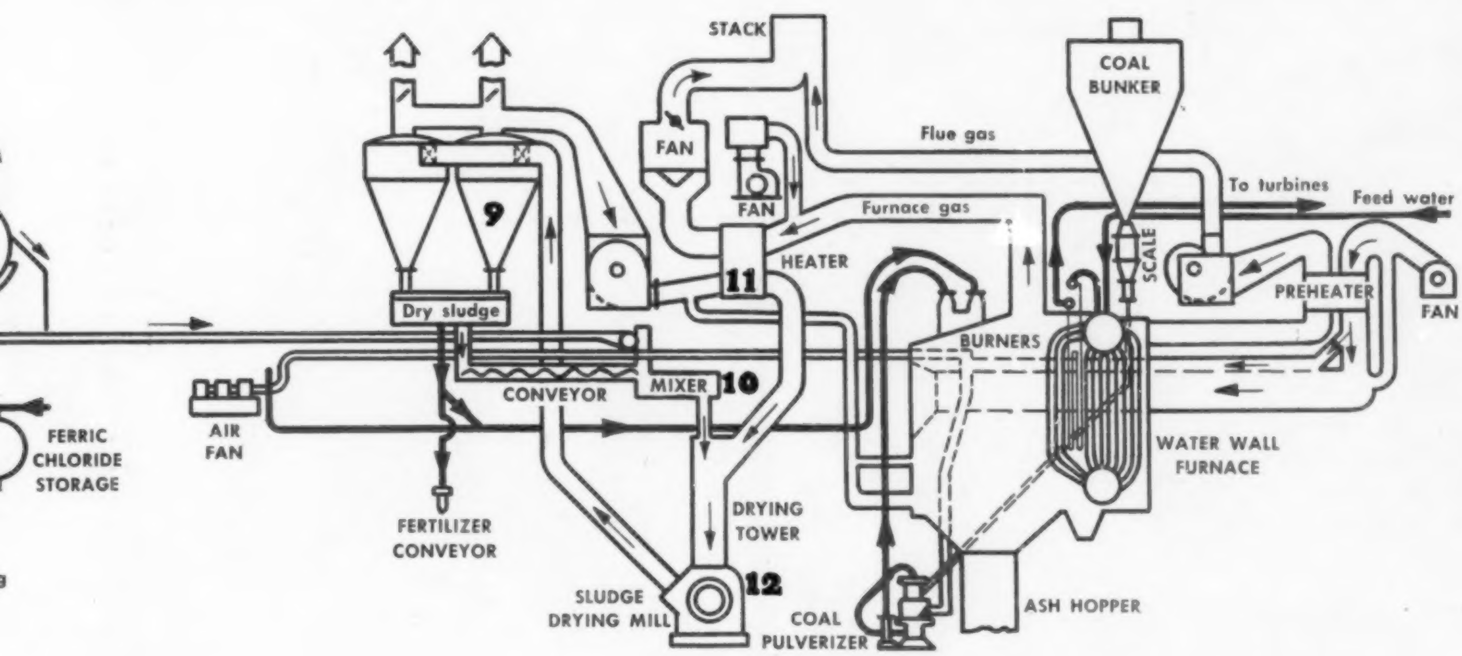






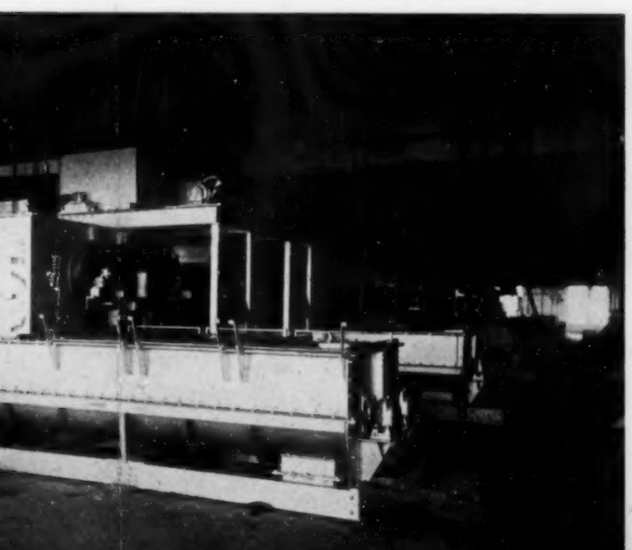
noved from the drying circuit by cyclone separators shown
stration

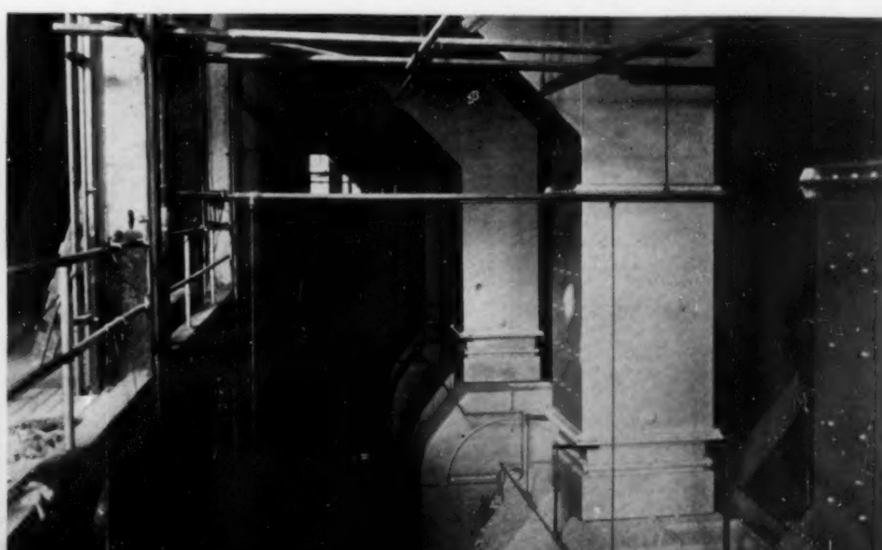
11 Rotating mechanical heat exchanger transfers heat from furnace gas in duct above to circulating sludge vapor in lower duct for drying sludge in suspension

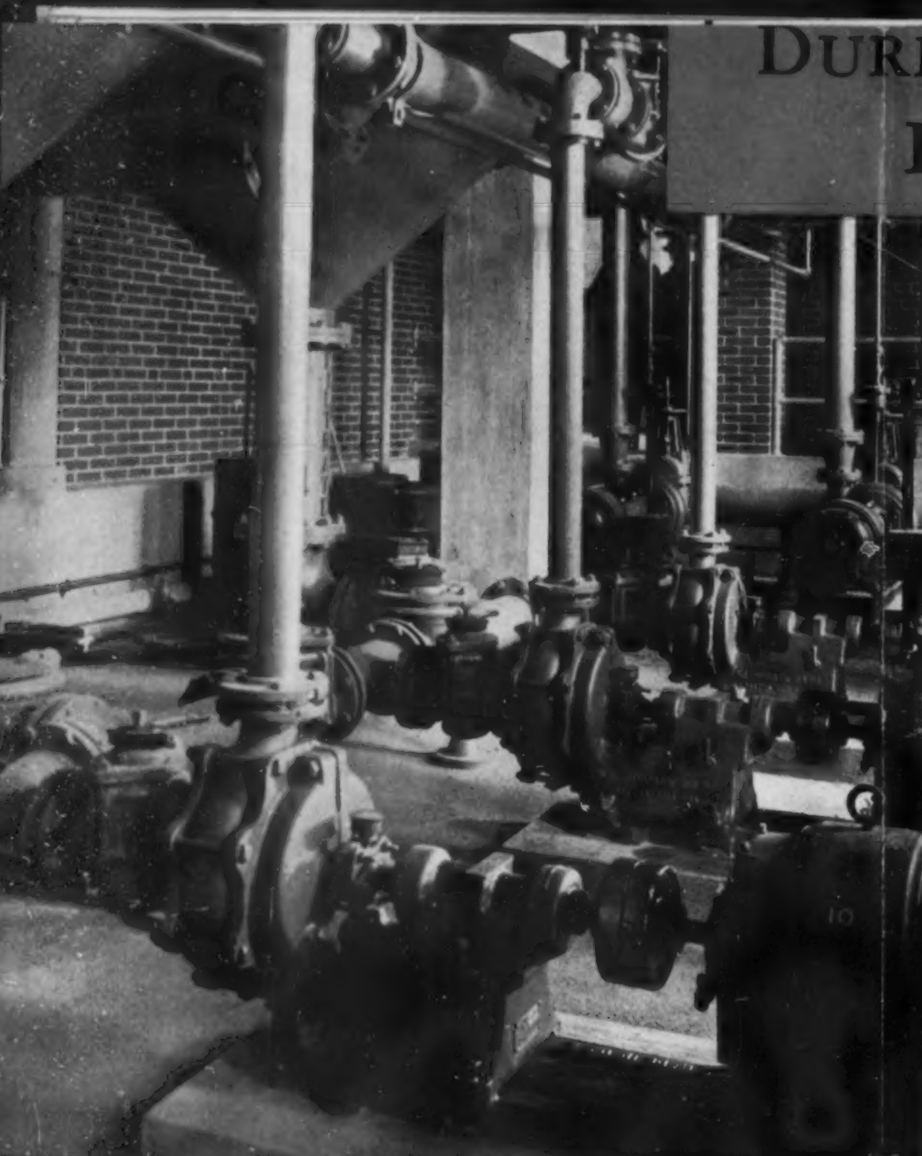


nd dried sludge are mixed in equal volumes in this mixer,
oist sludge which is discharged into drying medium

12 Squirrel-cage mills in sludge drying circuit break solids into fine particles for flash drying in suspension. Sludge vapor is the drying medium

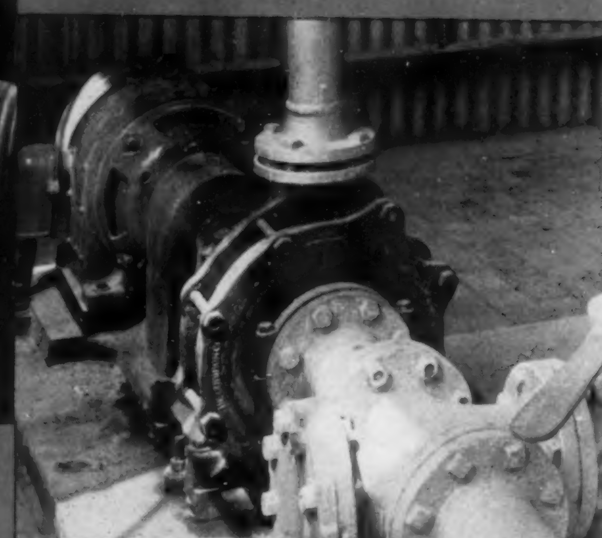






Duriron Company Equipment fits into the Flow Sheet of many chemical processes

•



Above: Duriron Pumps and Duriron-Nordstrom Valves used in water-treating plant in eastern city.

Right: Duriron Company cast iron pump with Durimet impeller pumping milk of lime in acid neutralizing.

Duriron Company Equipment is used by *consumers* of corrosive chemicals:

For instance:

In water treatment, *Duriron* pumps and valves are used for handling alum, ferrous or ferric sulfate; *Durichlor* pumps and valves for ferric chloride.

In acid neutralization departments, *Duriron* pumps are used to recirculate the solution of spent pickle liquor containing ferric sulfate and milk of lime.

Duriron Company Equipment is used by *manufacturers* of corrosive chemicals:

For instance:

In the manufacture of aluminum sulfate, *Duriron* equipment handles the sulfuric acid from strong acid to hot, weak acid.

Durichlor equipment is used with the saturated brines, hydrochloric acid and other chlorine compounds incurred in the manufacture of chlorine.

The manufacturers of sodium hydroxide and other caustics use *Durimet* equipment because of its high resistance to corrosive action of the alkalies.

All these corrosion-resisting alloys—*Duriron, Durichlor, Durimet* and *Durco Stainless Steels*—are used in the various stages of phosphoric acid production.

Take a look at your own flow sheet. The Duriron Company has a remedy for those spots of corrosion. Write today to see how we can help you.

THE DURIRON COMPANY, Inc.

NA

CHE

Technical, Industrial, Personal

WATER CARRIER REGULATIONS FOR CHEMICALS TRANSPORTATION

Splendid cooperation has marked the work of the Department of Commerce in drafting new regulations for the transportation of explosives, chemicals, and other dangerous articles on board vessels. The proposed regulations issued in November were the subject of informal public hearings during the second week of December. The final regulations will appear in the Federal Register early in January and will be effective on and after April 9, 1941.

The Bureau of Marine Inspection and Navigation, under whose jurisdiction these regulations have just been placed by act of Congress has specified details of transportation, storage, stowage, and use of all explosives and other dangerous articles on board vessels. In addition to the old classifications used by the Interstate Commerce Commission, all of whose container and label regulations will be accepted by water carriers, the Bureau has established two additional new classifications for dangerous articles. These are "combustitble liquids" and "hazardous articles."

Combustible liquids differ from inflammable liquids only in matter of flash point, being those which "flash" between 80° and 150° Fahrenheit. A hazardous article, is any substance "other than an explosive, inflammable liquid, inflammable solid, oxidizing material, corrosive liquid, compressed gas, poisonous article, or combustible liquid which is liable when subjected to test for three continuous hours in a Mackey apparatus at or below a temperature of 212° F. to spontaneous heating in excess of 10° F. or which at or below a temperature of 300° F. may liberate vapor susceptible to ignition by spark or open flame, or which in any other way will materially augment the rapidity and violence of fire."

Manufacturing Chemists Association and American Petroleum Institute were spokesmen for industry at the public hearings. In effect the new regulations put in legal form the safety precautions and present industrial good practice which have been developed and long urged. Those desiring copies of the issues of the Federal Register which contain the new regulations may obtain them at ten cents per copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.

SHORTAGE OF SULPHITE PULP INDICATED BY SURVEY

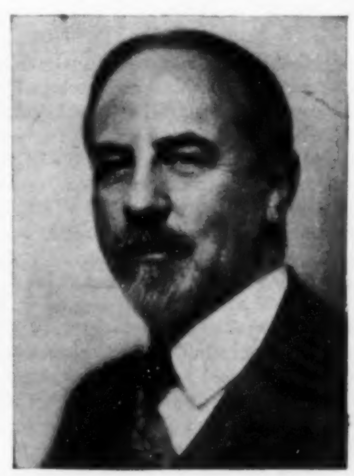
Curtailment of exports from northern Europe and the readjustment of overseas markets are intensifying the shortage in certain grades of woodpulp. This is the conclusion reached by A. E. McMaster of Vancouver, B. C., who has completed a survey of the pulp situation with particular reference to the Pacific Northwest.

A shortage of unbleached sulphite pulp will probably become serious by early 1941, according to this survey, and it can be overcome only by providing additional manufacturing capacity and by sacrificing exports, which would be inconsistent with the foreign policies of Canada and the United States.

There may be a natural hesitancy in making large capital investment in mills in view of the uncertainty of the position after peace is restored, but there is no physical difficulty in the way except some delay in securing part of the equipment. Construction would probably take about a year from the time of commencement, the survey points out, adding that the important problem facing new interprises of this kind is the nature of the competition which will have to be met when European exports are resumed.

DR. J. V. N. DORR RECEIVES PERKIN MEDAL

The thirty-fifth impression of the Perkin Medal, awarded annually by the American Section of the Society of Chemical Industry, was presented to Dr. J. V. N. Dorr, president of The Dorr Co., Inc., on the evening of Jan. 10. The presentation was made at the



Dr. J. V. N. Dorr

Chemists' Club, New York, at a joint meeting of the American Chemical Society, American Institute of Chemical Engineers, The Electrochemical Society, and Societe de Chimie Industrielle.

Dr. Lincoln T. Work presided and the program included an address on "The Personal Side of the Medallist" by G. H. Dorr, "The Accomplishments of the Medallist" by Dr. M. H. Whitaker, and the presentation of the medal by Dr. M. T. Bogert.

In his speech of acceptance, Dr. Dorr took for his subject "The Engineer and His Responsibilities in the World of Today and Tomorrow." He touched upon a subject that has been uppermost in his mind for many years. He has been keenly interested in the potentiality of the engineer's genius as a means of furthering the advance of civilization. He expressed the hope for a closer bond of affiliation between the engineers of the world, resulting in a force, while primarily non-political, yet aiming to make the engineer a most useful citizen of the world, to assist in solving the problems of today and tomorrow.

ALCOHOL CONTENT INCREASED IN NITROCELLULOSE

The Hercules Powder Co. has announced that on or about Jan. 15, it will increase the volatile content of all types of its nitrocellulose to a minimum basis of 35 per cent. The company explains its announcement by expressing belief that in the near future, government agencies will consider the advisability of increasing the present alcohol content of nitrocellulose from 30 per cent to 35 per cent because of conditions arising from the present defense program and the necessity of surrounding the use of all types of nitrocellulose with extraordinary precautions. Because of the anticipated change in governmental regulations and because raising the volatile content will lower the potential hazard, all shipments of nitrocellulose made by the company in the future will conform to the new 35 per cent alcohol standard.

GOVERNMENT SEEKS CHEMISTS WITH EXPLOSIVES TRAINING

The U. S. Civil Service Commission announces open competitive examinations for chemists to plan, supervise, conduct, or assist in conducting investigations, research work, or development work in explosives chemistry. The positions open range from principal chemist to assistant chemist with salaries ranging from $2,600 per year to $5,600 per year. Competitors will not be required to report for examination at any place but will be rated on the extent of their education, on the extent and quality of their experience, relevant to the duties of position applied for.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

How close to war are we? This is the biggest question in Washington during January. It has many variations. But there seems to be a general feeling that the United States must take the responsibility of becoming an active ally of Britain even though our men do not shoot the guns or man the planes that are actually in the fighting.

To achieve the necessary speed in manufacture for effective support of Britain there have been a number of very fundamental changes made in government policy. In the first place, Mr. Knudsen has been made definitely the chairman of a Super Board with much more authority from the President than has previously been granted to anyone. And there is now open admission of the fact that defense manufacture is going to take all the goods it needs, including some goods that other civilian industry really wants badly. Thus, there has been discarded the old policy that we must plan enough goods to supply both defense preparation and normal peace time requirements.

As Congress resumes regular sessions in the 77th Congress there is every appearance of controversy over policy in international relations. But the President will be supported in every necessary move. His plan to "lend the garden hose" to the British will be approved in some form or other, and promptly. The opposition minority is nothing like as large as it might seem from the noise which it makes.

Defense Materials

The program for defense still considers it the job of Mr. Stettinius to get all the necessary raw materials for Mr. Knudsen's manufacturing division. Fortunately, however, there is no attempt to draw a sharp line between the two activities. For example, ammonia is a raw material. But the program for it ties in so intimately with explosives making (which is manufacturing) that the plans for the two classes of chemical production are considered together very carefully.

Very considerable expansion of the whole chemical munitions program is expected this Spring. Officials have no hesitancy in admitting that the capacity to produce these things must be built up so that we could supply a four-million man army in case of need. As formerly, the capacity will be prepared even though all the men to use the full capacity may not actually be in uniform at any one time. And Washington still hopes that actual field operations by American troops may never be necessary.

Increased capacity of iron and steel plants, including coke ovens, is being encouraged by the government. The first announcement of such development was made by the owners of Birmingham properties. The government is buying Chilean nitrate as a reserve, but for the present is leaving most of this actually in Chile. It is also buying Chilean copper, to provide adequate supplies in the United States without necessity of price increases. Other negotiations for all the other classes of metal, mineral, and chemical raw materials continue actively.

Real shortages of these raw materials have not developed. There has been considerable newspaper talk about shortages of aluminum. Official investigation has failed to disclose any case in which there has been shortage of the metal itself. The difficulties have been with aircraft companies who failed to place orders, who failed to coordinate their program for expanded production as promptly as desirable, or (in a small way) with shortage of capacity to make forgings of aluminum alloy. This latter difficulty is being corrected and the airplane builders are working out their speed-up program with government aid. It is expected that all this should eliminate any future claims of this kind of difficulty with respect to aluminum.

Expansion of the magnesium program is going on also very rapidly. But the demands apparently are rising faster than the capacity to produce, which suggests probable further new construction plans, some of which may be announced during January.

Rubber and Tin Troubles

Probably the most serious delay in raw material supplies has occurred with respect to tin smelting and synthetic rubber manufacture. Negotiations with industry for new construction in these two fields has been going on for some time under the auspices of R.F.C. subsidiaries. Privately the R.F.C. is getting very sharp criticism for its lagging proceedings.

There is some speculation as to how long it may be before the President or Mr. Knudsen undertakes to crack down on Jesse Jones' subordinates who are handling these matters through Rubber Reserve Co. and Metal Reserve Co. Obviously, the patience of some of the divisions of the government is almost exhausted.

Tied in with these required raw materials normally brought from the Orient are the problems of export control. Listed below are the groups of commodities of chemical significance which were put under export license regulation by the President during December. Still more significant is the recent talk about controlled purchases from Japan. This is the way the talk goes:

The United States could do without silk imports for some time. Present stocks in the United States would care for essential needs for quite a while. If this government desires to discipline Japan further, this perhaps could be accomplished by forbidding the imports of silk from that country. The theory is that the internal economy of Japan would be so upset by inability to sell silk that there would be popular unrest and the military clique of the Japanese government might thus be restrained, if it did not actually pass out of power.

Synthetic Rubber Supplies

Common-sense cooperation and voluntary allotment of synthetic rubber supplies among producers and users is the recipe the defense commission is relying upon to iron out a "situation" which has developed in this commodity because of sharp upsurge in military requirements. Priorities are not in the picture right now and won't be if the defense commission can find ways of avoiding them. The problem as seen by the defense commission is not really as much one of a production shortage as it is of utilizing production facilities wisely and fully.

Because it is the oldest and most produced synthetic, neoprene is the widest sought of the artificial rubbers by makers of those commodities commonly made with the artificial product. Defense commission experts feel that other synthetics are satisfactory for many uses and that a little more willingness among buyers to take supplies that are available would go a long way toward easing the problem of making the total production go around.

To stimulate this spreading of use, the defense commission now has under study revision of Government specifications. Where now specifications practically or actually call for neoprene in many cases, it is planned to work out performance standards which can be met by products made from several types of artificial rubber and in some cases even from crude.

Export Controls

On December 10 the President put under export-license regulation iron and steel, pig iron, ferro alloys, and a considerable variety of semi-finished and finished products made from iron and steel. This move was definitely planned to restrict the movement of ferrous metal products to Japan.

On December 20 the President put the following additional commodities under export-license control: bromine; ethylene; ethylene dibromide; methylamine; strontium metals and ores; cobalt; abrasives and abrasive products containing emery, corundum, or garnet, as well as abrasive paper and cloth. Also included on the list at that time were various types of machines and devices for plastic molding, measuring, gaging, testing, and so forth. The list further included equipment and plans for the production of aviation lubricating oil.

Administration of the export license program is being continued as formerly. This means that our friends get all they want, so long as we can spare it. Other folks, notably the Axis groups and their friends, get little or nothing.

The export control program is not being administered in any blunderbuss fashion. If it is known that Japan can get a wanted material elsewhere if the United States refuses to supply it, then American companies are not being restricted. Only when cutting off goods movement from the United States produces the desired effect of stopping supplies to those whom we wish to restrict, does the government proceed drastically.

Defense Program

Any policy the American democracy adopts in the present world upheaval involves some risk-taking. Least risk lies in this country becoming the "great arsenal of democracy" to insure that Britain defeats Hitler, thus avoiding our own participation in a "last-ditch" fight with totalitarianism. In other words, limited belligerency (short of an expeditionary force) now is better than fighting off attack later.

Not new but now more sharply defined, this policy points up the distinct change of tempo of the defense production program which arrived with the New Year. Growing apprehension in Administration circles that the coming spring will decide whether Britain wins or loses explains why the pressure has been applied more vigorously, why viewpoints have been modified, why new goals are being fixed.

Two clearly-outlined milestones warned of this shift in mid-December, and the President put his own stamp of approval on them just before New Year's. First of these was the outbreak of a fundamental controversy in Washington over the extent to which a military economy shall be allowed to interfere with a civil economy; second, the plans of this Government to assume the procurement problems of Britain. The President "settled" the first with his unmistakable enunciation that guns come ahead of butter although the over-all policy still demands that provision be made to supply enough butter by unstinted expansion to make up for the military subtraction from the productive capacity.

From a total production standpoint, President Roosevelt's scheme to have this country take over all future British orders and then lend them needed material, or whatever modification of this program which develops, essentially means little. Combined British and American munitions orders now are ahead of productive capacity to fill them; consolidation of the two sets of orders doesn't materially alter this.

This projected consolidation of British and American buying is in the future. Of more immediate concern and effect is the "speed-up" campaign to get increased output right away. U.S. arms production is geared for maximum operation a year from now.

The concrete development to meet this immediate challenge was creation of the Office of Production Management to have all the power which "can legally be delegated to it"—power short of infringement upon Mr. Roosevelt's final right of say-so. The Knudsen "super-board" is the first real compromise with the original viewpoint that re-armament could be a luxury superimposed upon "Business as usual." With the production division of the original defense commission elevated to a position of ranking authority, the job of the Stettinius division becomes not so much one of feeding the armament machines, but more one of planning for adequate supplies for civilian needs over and above—and after—satisfying the requirements for defense. In only a relatively few instances are there actual shortages of the things needed for the military in ratio to total productive capacity.

The original viewpoint of superimposing defense upon normal business inevitably relies upon wholesale expansion of those industries which serve both civil and military needs. The new "all-out" supply program recognizes that expansion is a luxury which takes time to acquire and requires that civilian needs wait for that day.

Funds for Munitions Plants

The Army juggled its huge defense appropriations around last month to provide additional funds for expanding its chain of munitions plants. Roughly speaking, the re-allocation makes available another $200,000,000 for construction of plants, most of which will go into such facilities as powder works, ammunition loading assemblies and plants for producing chemical raw material components of explosives. These extra funds were accumulated for the most part by switching some operating costs which originally were assessed against the $700,000,000 appropriated for "expediting production" to money supplied the Ordinance Department for procurement.

Two of the facilities made possible by this shift in bookkeeping already are under contract—the ammunition loading assembly at Milan, Tenn., and the TNT-DNT plant at Sandusky, O. A third use of this money was the allocation of another $23,000,000 to the Charlestown, Ind., smokeless powder works to be operated by DuPont. This now becomes a $74,000,000 factory, scheduled ultimately to have a capacity in excess of 600,000 lb. of powder daily. Other plants under negotiation include another smokeless powder factory to be located at Childersburg, Ala., and the small arms ammunition assembly to be operated by Remington Arms at Denver.

Total construction and equipment cost of the powder and ammunition plants underway at the start of the new year totals more than $300,000,000. Operating funds already allotted to these plants as orders for finished products totaled another $350,000,000.

Yet to come are munitions works costing in excess of $100,000,000, including those made possible by the additional "nest egg" and a few from original schedules for which operating management and sites have not yet been signed up. Conspicuous among this latter group is an ammonium picrate works, a project which has blown hot and cold by turns for months. Projects in the original list for which contracts are not signed also include two bag loading establishments to be operated in connection with the Radford, Va., and Charlestown, Ind., smokeless powder works.

New Management Policy

The Army's difficulty in spreading experienced management to meet the far-flung range of its munitions plant chain has resulted in decision to offer some of these jobs to established private companies whose normal activities are in unrelated fields. First example of this was the award in late December of operation of a $14,000,000 ammunition loading assembly to a specially incorporated subsidiary of Procter & Gamble. Other management contracts are expected to be distributed similarly in increasing proportion as the production program expands. So far, however, it is planned to confine this policy to the more mechanical type operations, as distinguished from process type plants.

The difficulty of finding sufficient management for process operations such as powder manufacture, is being met by further concentration of these facilities into a relatively few locations. Chief exhibit to date is the Charlestown, Ind., smokeless works which originally was planned as a $25,000,000 project but since has been enlarged twice to triple its original size.

The New Year brings plans for a second large-scale chain of munitions plants in many respects duplicating the program now a-building. The budget figures sent to Congress early in January are not conclusive as regards the size and scope of this new facility program; everyone expects that additional appropriation requests will be made during the session from time to time as needs and plans crystallize.

It is safe to assume that funds for construction of additional powder, powder components and ammunition facilities to be provided for in the 1941–42 fiscal year budget will top a quarter-billion dollars. Production capacities of this much more than now programmed the Army wants for the United States defense program alone.

How much of British needs can be supplied from these same plants is the question upon which will hinge the extent to which the new construction program will exceed that estimate. There can be considerable doubling up in this respect because as long as this country is not in a "shootin' war" production capacity to make powder and bullets is required far in excess of the amounts of finished products.

SCARCITY OF CONTAINERS HAS AFFECTED DELIVERIES OF GOODS IN GERMANY

From Our German Correspondent

THROUGH Portugal and Switzerland reciprocal machinery for renewal of patents and licenses held in enemy territory has been set up by Great Britain and Germany. Regulations concerning a number of important German chemical and metallurgical patents used in Britain, and English patents used in the Reich, have not been widely publicized since they involve delicate interpretations of respective Trading With the Enemy Acts. The arrangement is of interest in view of the controversy over German chemical patents held in the United States during the last war. This time British and German patent holders are apparently assuming that patent rights will be reestablished after the war even though in the meantime renewal fees are not always being paid.

Partly because it is difficult to evaluate assets of German firms abroad and partly to prevent divulging business information of possible military importance, under a decree of the Reich Council of Ministers for National Defense dated Oct. 4, 1940, German corporations and individuals engaged in business are relieved of publishing annual balance sheet and profit and loss statements.

What is also not being divulged for obvious military reasons is the extent of damage inflicted by R.A.F. fliers to Reich industrial plants. To anyone familiar with the geographical location of German factories, a list of objectives attacked by British fliers reads like a guidebook to Germany's chemical industry. Although official Reich reports have denied much damage has been done and American correspondents allowed to inspect some of the plants claimed to have been destroyed, the British have repeatedly bombed factories at Frankfurt and Mannheim-Ludwigshafen, seat of key I.G. plants. The R.A.F., apparently aiming at Germany's vulnerable oil supply, claims to have hit a number of synthetic oil plants, among them the factory at Politz near Stettin, with an annual capacity of one million tons of motor fuel, the I.G. hydrogenation plant at Leuna near Leipzig, the Brabag units at Madgeburg, refineries at Gelsenkirchen, the Hoesch benzine works at Dortmund, and additional oil plants and stores at Hamburg, Hanover and Frankfurt.

Details of German self-sealing airplane fuel tanks have been made public by British aviation authorities after testing of bombers shot down over England. The tanks have a capacity of 280 gallons. The tank wall weighs 4½ lb. per sq. ft. and is stated to be about two and a half times as heavy as that used in British aircraft. The outer covering is of vulcanized rubber which encases several layers of pure rubber, inside of which is a compound of rubber-like self-sealing fluid. Then comes a layer of strong leather, and the inner tank itself, which is constructed of fiber like a suitcase. Metal braces and tough fiber supports are put in to give the tank the necessary strength. In tests, sections of the tank have been broken in two, and then by pushing the broken parts together, in a short time they fuse themselves.

Packaging, rather than transportation, difficulties are claimed to be responsible for delays in filling orders and for production and distributing "bottlenecks" in the Reich. This was apparent when only very late delivery terms could be offered at the Leipzig fall fair. The shortage applies to small as well as large containers. Recently the "Chemiker Zeitung" issued an appeal to large consumers to return packaging materials if they wanted faster deliveries. To speed the return of oil drums and barrels a new decree requires payment of 40 RM for a 200-liter barrel and 50 RM for a 300-liter barrel if it is not returned to the manufacturer by a farmer within five months after delivery and by an industrial plant within three months.

In the case of smaller containers, there are now five or six plastic tubes available for holding pastes and liquids. One difficulty in changing over to new types of containers once they have been developed is that automatic packaging machines already in use have to be remodeled or discarded. Similarly, the design and construction of machinery to turn out containers, such as the new plastic tubes, in mass production requires considerable time and money.

The shortage in packaging materials is of course due to the fact that the metal supply is being diverted to military purposes. The tin can output is reported to be greatly reduced compared with last year. One way of getting around using tin is to make a container of untinned sheet covered by a film of synthetic resin lacquer. Plans have been drawn up for large scale manufacture in the Reich of untinned plate cans treated by the Bonder phosphate rust-proofing process. Because of the paraffin shortage, paper boxes are no longer waxed but are being lined with cellophane. Glass jars are widely supplanting tin cans for preserving vegetables and fruits.

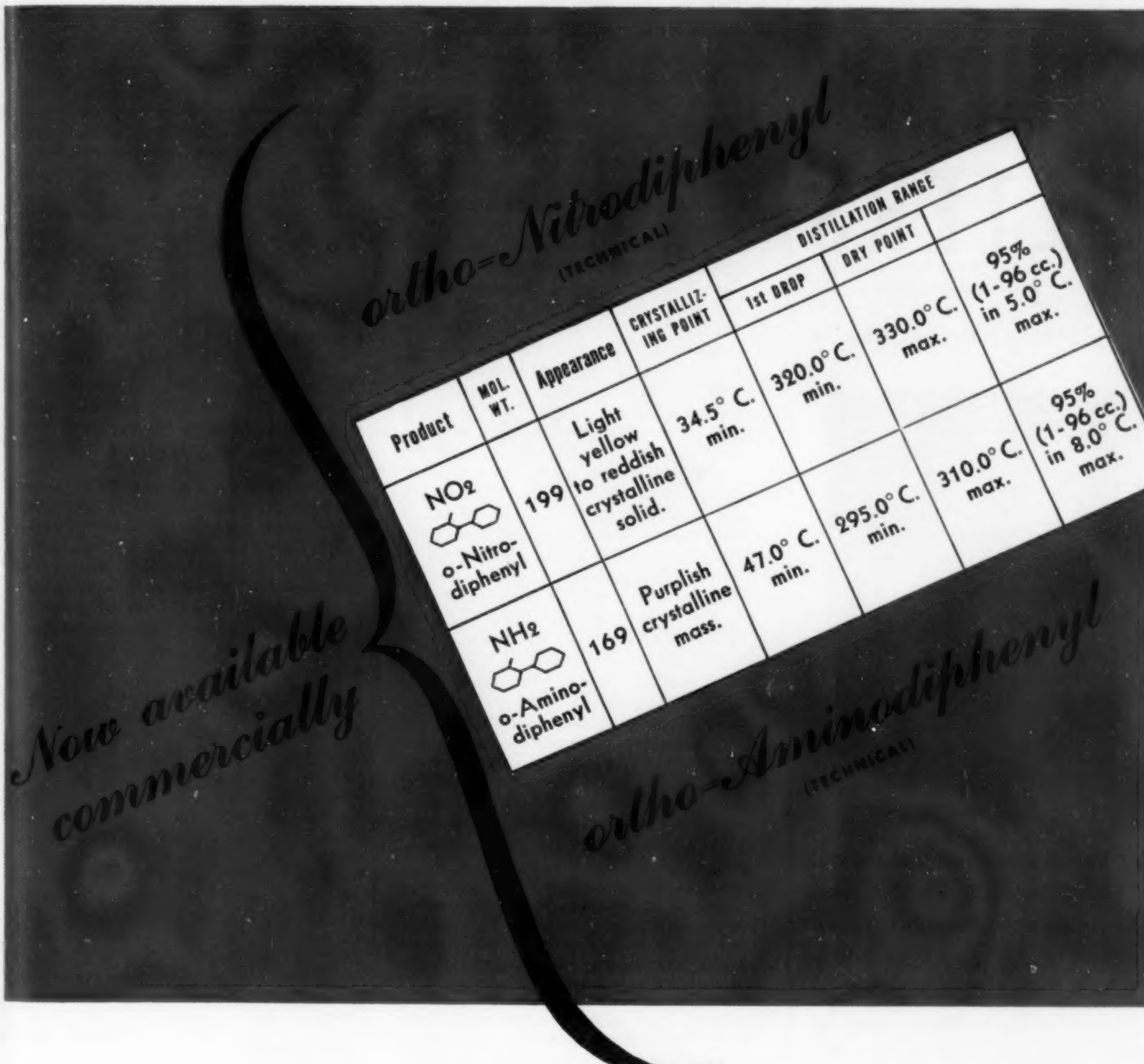
Quick-freezing is another process by which tin containers are being eliminated. There are 74 quick-freezing plants operating in the Reich and 64 more are under construction. The frozen foods industry's output was 25,000 metric tons in 1940 and in 1941 it is planned to increase production to 120,000 tons. Because of the lack of certain materials the quick-freezing processes in Germany differ somewhat from those used in the United States. Ammonia, which has heretofore been used as a refrigerant in the Reich, is being rapidly replaced by "Frigen," an I.G. product. Freezing units are also being installed on fishing vessels, the most recent being on a new 10,000 ton steamer put into service by the Deep Sea Fishing Co. of Hamburg.

The shortage of fats and oils has resulted in a deterioration of soaps in the Reich. The new standard "Einheitsseife" contains not more than 40 per cent fat or grease, the remainder being chiefly kaolin. The soap bars are plain and undecorated, having only "R.I.F." embossed on them. Regular soap is still manufactured for export, but producers report increasing difficulties in obtaining raw material supplies. A sidelight to soap rationing, which allows each male only one three-ounce stick of shaving soap every four months, is the trend toward using dry electric razors, manufactured in the Reich chiefly under Dutch and Italian patents.

For industries where hands are exposed to strong alkalies, a new soap has been developed in the Reich. It contains 50 per cent Turkey red oil, 20 per cent liquid paraffin, and 30 per cent water. The liquid soap is used without water and does not lather much, but it is claimed to clean workers' hands without taking too much oil out of the skin.

Another waste recovery process is a new patent, DRP 660,622, which produces fertilizer and alcohol from industrial sulphite waste. The new process differs from that used heretofore in which the calcium present in waste water is precipitated by means of phosphoric acid or phosphates, a large part of the calcium phosphate remaining in solution. The new process calls for adding calcium to the alkaline water to produce an insoluble precipitate of calcium phosphate, along with colloidal organic matter, which makes it a very satisfactory fertilizer. The residual solution, which contains sugar, can be processed to alcohol.

A waste product of the acetylene industry, carbide lime, is finding new uses since under a new process it can now be cleaned of impurities better than heretofore. It is being used in the building industry in the place of slaked lime for mortar and as whitewash. In agriculture it can be used as an insecticide and protective coating for trees and as a fertilizer to counteract soil acidity. An easing of the supply of fertilizer is to be seen in a recent decree of the Reich Chemical Board which raised the quota allotments of phosphoric fertilizers to farmers from 25 to 40% of 1938–9 purchases in the Old Reich and up to 48% in Austria and the Sudetenland.



Product	Mol. Wt.	Appearance	Crystallizing Point	Distillation Range 1st Drop	Dry Point	
NO_2 o-Nitrodiphenyl	199	Light yellow to reddish crystalline solid.	34.5° C. min.	320.0° C. min.	330.0° C. max.	95% (1-96 cc.) in 5.0° C. max.
NH_2 o-Aminodiphenyl	169	Purplish crystalline mass.	47.0° C. min.	295.0° C. min.	310.0° C. max.	95% (1-96 cc.) in 8.0° C. max.

The chemical configurations of *o*-Nitrodiphenyl and its reduction product, *o*-Aminodiphenyl, suggest a number of possible uses as intermediates in the synthesis of dyestuffs, insecticides and plastic compositions.

The amino compound will give any of the characteristic reactions of an aromatic primary amine. It may be considered where a weighted aniline is indicated to obtain certain desired results.

The current prices of 6¢ a pound for the nitro and 12¢ for the amino compound compare favorably with other materials of similar chemical reactivity.

Both of these compounds are available in commercial quantities. Requests for samples are invited. MONSANTO CHEMICAL COMPANY, St. Louis, U. S. A.

MONSANTO CHEMICALS
SERVING INDUSTRY ... WHICH SERVES MANKIND

TWELVE STUDENT CHAPTERS WERE REPRESENTED AT NEW ORLEANS

One of the most successful conventions of members of Student Chapters of the American Institute of Chemical Engineers to date was held at New Orleans in December in conjunction with the meeting of the American Institute of Chemical Engineers. The Student Chapter at Tulane University served as host, and was assisted by the Chapter at Louisiana State University. Dr. F. M. Taylor of the Chemical Engineering Department at Tulane headed the local committee arranging the meeting. Registrations exceeded one hundred and fifty, representing twelve Student Chapters.

W. A. Wood, Jr., president of the Tulane Chapter, presided at the opening meeting, at which the speakers were Dean James M. Roberts and Dr. F. M. Taylor of Tulane University, Dr. C. S. Carlson of Louisiana State University, and Dr. M. C. Molstad, chairman of the Institute's Committee on Student Chapters. Following a symposium on "The Chemical Industry in the South", addressed by Dr. R. L. Copson, H. G. Mangelsdorf and Arthur L. Stern, the audience formed nine discussion groups. At these the opportunities for chemical engineers in plant operation, process development, research, and sales were informally discussed by competent industrial leaders. Among these leaders were men engaged in such important southern industries as petroleum, paper, sugar, fertilizers and food products.

Dr. C. S. Williamson, Jr. was toastmaster at the banquet, at which S. D. Kirkpatrick spoke on "The Chemical Engineer in National Defense."

M.C.A. ISSUES YEARBOOK OF CHEMICAL INDUSTRY

Last June announcement was made that the Manufacturing Chemists' Association was preparing a statistical yearbook of the American Chemical industry. The new publication was released under date of Dec. 18, bearing the title "Chemical Facts and Figures." It contains 220 pages with a detailed index and includes factual data, graphs and statistics on chemical production, sales, foreign trade, employment, safety, research, and finance. As certain data for 1939 were not available from the Bureau of the Census at the time of publication, a mimeographed supplement will be issued as soon as these figures have been received.

SHELL OIL CO'S TOLUOL PLANT IN OPERATION

More than a month ahead of schedule, America's first commercial petroleum toluol refinery began producing in December. The first barrel of the new process product was taken off the Shell Oil Co.'s Houston plant four months after ground was broken for the building.

The Shell plant is equipped for a production rate of 2,000,000 gal. annually, sufficient for 20,000,000 lb. of TNT. The present plant operates on an extractive, rather than a synthetic process. A second process of rearranging petroleum molecules, which can be operated supplemental to the first, could increase output at Houston to 10,000,000 gal. annually.

In addition to this privately-financed refinery, the Army has given Humble Oil Co. more than $11,000,000 for construction and operation of a similar toluol plant at Baytown, Tex. This facility will be government-owned, part of the vast chain of munitions plants being strung out over the country by the Army.

GERMAN POST-WAR CHEMICAL TRADE WITH THE BALKANS

A report to the Department of Commerce states that Germany's chemical industry is reported to have formulated elaborate plans for expanding its trade in Southeastern Europe at the conclusion of the war. While many German indstries are expected to participate in supplying the contemplated enlarged economic requirements of this region, it is believed that the chemical industry will draw the greatest benefits in view of the existing low per-capita consumption of chemicals and the wide-spread possibilities for expansion in this field. Trade authorities in the Reich lay especial emphasis on the opportunity which will develop of increasing the demand in the Balkan area for agricultural chemicals, notably artificial fertilizers and insecticides, consumption of which is capable of prodigious increase in view of the present low level of consumption. Modernization of Balkan agriculture would involve a sharply increased demand for other products of the chemical industry, including preparations for safeguarding livestock against infections, paints and related products for farm buildings, plastics and supplies for dairies.

MONSANTO ESTABLISHES PENSION PLAN FOR EMPLOYEES

A formal plan which will enable employees of Monsanto Chemical Company to retire with a dependable and comfortable pension when they reach the age of sixty in the case of women, and sixty-five in the case of men, has been approved by stockholders. The amount of the pension when combined with governmental pensions will approach fifty per cent of average earnings for employees of long service earning less than $3,000 a year.

Employees receiving less than $250 a month participate in the benefits of the plan without cost, and those receiving more than $250 a month will have an opportunity to retire on a pension commensurate with their earnings upon payment into the plan of four and one-half per cent of their earnings above $3,000 a year.

CANADIAN RESEARCH ON CHARCOAL FOR GAS MASKS

Publication of a paper on activated charcoal, by Dr. M. J. Marshall of the University of British Columbia chemistry department has brought to light extensive U.B.C. research in this field which is supplementing Canadian research on charcoal suitable for gas masks.

"The National Research Council enlists our support from time to time in connection with new gases," Dr. Marshall said, revealing that practically all U.B.C. graduates in the field of chemistry would be called up by the government for war research immediately upon graduation.

Charcoal, formerly made from cocoanut shells, is now being made from wood such as the Douglas Fir as a result of late scientific developments. This process has now been perfected at the University of British Columbia Dr. Marshall stated, but has not been undertaken on a commercial scale.

CHEMICALS USED TO STABILIZE OUTPUT OF ORCHARDS

A new way of attacking the problem of biennial bearing of apple trees is suggested by successful experiments by the Bureau of Plant Industry of the Department of Agriculture. An orchard of York Imperial trees has been "changed over" from a practice of bearing a heavy crop in odd years and a light crop in even years by use of tar oil distillate and di-nitro-cyclo-hexyl-phenol sprays when the blossoms were in the early pink stage. Additional research is now underway to see if this method can be used to kill only part of the blossoms in a "heavy" year, thus keeping production on an even keel. For the last eight years, in parts of the eastern part of the country, many orchards have borne alternately heavy and light crops, with consequent disruption of market prices.

PENN SALT WILL BUILD CHLORATE PLANT ON WEST COAST

Bonneville Administrator Raver claimed credit for bringing another new industrial operation to the Pacific Northwest in announcing execution of a contract for 2000 kilowatts of Bonneville-Grand Coulee power with the Pennsylvania Salt Manufacturing Co. of Washington to supply a sodium chlorate plant. The company, subsidiary of Pennsylvania Salt Manufacturing Co. of Philadelphia, already operates a plant at Tacoma, Wash.

Construction of the new chemical works at Portland, Ore. will start at once and be completed late in 1941. Bonneville will begin supplying 1000 kilowatts initially when the company starts production, increasing deliveries 200 kilowatts monthly until the contract figure is reached. Contract price was announced as Bonneville's standard rate of $17.50 per kilowatt-year.

PERSONALITIES

Robert B. Wittenberg

C. C. DeWitt

✦ Robert B. Wittenberg, who has been in charge of market research for Mathieson Alkali Works, resigned Dec. 31 to accept a position with International Agricultural Corp., New York, N. Y. Mr. Wittenberg will engage in development of markets and sales of minerals and chemicals.

✦ Elmer Ghrist has been appointed metallurgist for the Jessop Steel Co., Washington, Pa. He graduated from Washington & Jefferson College in 1932 and has since taken graduate work at Carnegie Institute of Technology. Mr. Ghrist has been employed by the steel company since 1935, having served two years in the chemical department and three in the metallurgical department.

✦ Clinton D. St. Clair has been appointed works manager of the Hancock Valve Division, in Boston, of Manning, Maxwell & Moore, Inc. Mr. St. Clair attended Rutgers University and Pennsylvania State College. Since graduating he has had manufacturing experience with such prominent industrial organizations as B. F. Goodrich, Ohio Match Co., and Erie City Iron Works. His duties for the past 15 years have been similar to those of his present capacity and especially fit him for his new work.

✦ Allen Abrams has been elected vice president in charge of research by the board of directors of Marathon Paper Mills Co., Rothschild, Wis. Dr. Abrams is a past president of the Technical Association of the Pulp and Paper Industry and one of the leading technical men in the industry.

✦ George K. Budd has accepted a position with the Campbell Soup Co. He will be located at the company's plant at Camden, N. J.

✦ C. C. DeWitt is now chairman of the department of chemical engineering, at Michigan State College of Agriculture and Applied Science, Lansing. In 1927 Dr. DeWitt received his Ph.D. degree from the chemical engineering department of the University of Michigan. He was assistant and associate professor of chemistry and chemical engineering at the Michigan College of Mining and Technology, Houghton, from August 1927 to September 1940.

✦ H. Bennett, director of research and development of the Glyco Products Co., left on December 20 for a business trip to South America. While there he will confer with representatives of the company and others who have been actively connected with the building up of Glyco's business in South America.

✦ Lawrence C. Turnock, Jr., of Cleveland, Ohio, of the chemical engineering department, at Massachusetts Institute of Technology, has been given the William Barton Rogers Award of $300 in recognition of high scholarship, character and leadership in student affairs at the Institute. Mr. Turnock is a member of Alpha Chi Sigma, Tau Beta Pi, the Track Club, Scabbard and Blade, and other honorary organizations.

✦ H. Seymour Colton has purchased the Cosma Laboratory Co. of Cleveland, Ohio, and has incorporated his consulting practice with this organization. The Cosma laboratory has been in business in the same location for over 20 years, serving industry throughout the middlewest.

✦ Robert L. Lerch has been appointed general sales manager of Haynes Stellite Co., unit of Union Carbide & Carbon Corp. Mr. Lerch has been associated with Haynes Stellite since 1924. During the World War he served in the U. S. Marine Corps. After the war he returned to Lehigh University, from which he was graduated in chemical engineering in 1922. He then spent a year and a half in various plant departments of the Bethlehem Steel Co.'s Lehigh plant, Bethlehem, Pa. Since 1929 he has been advertising manager and assistant to the general sales manager.

✦ Otto Kessler, a chemical engineer for many years with General Chemical Co., has become associated with the enlarged chemical division of the Foote Mineral Co., Philadelphia. He will devote most of his time to production problems of this division.

✦ Philip J. Baker, a recent graduate of Northwestern University, Dr. Richard S. Egly and Dr. Graham W. McMillan, both graduates of the University of Illinois, and Dr. Ambrose G. Whitney, from the University of Minnesota, have been added to the staff of the research department of Commercial Solvents Corp.

✦ G. Cecil Rhodes, who graduated in June 1940, from the department of ceramic engineering at the University of Illinois, is now employed in the Research Mineral Rock Wool Division of Johns-Manville Corp. at Manville, N. J.

✦ William R. Morgan, who received his Ph.D. degree from the University of Illinois in 1937, is now director of research for the Bay State Abrasive Products Co., Westboro, Mass. Before accepting this appointment he was associate professor of ceramic engineering at Rutgers University.

✦ W. Harry Vaughn has accepted a position as chief of the regional products research division, Commerce Department, T.V.A., located at Knoxville, Tenn. To fill this appointment he is taking a year's leave of absence as director of the State Engineering Experiment Station and head of the department of ceramic engineering at Georgia Tech.

✦ J. Howard Wright, who at one time was chemist for the National Paper Products Co., Carthage, N. Y., recently joined the chemical department of Southland Paper Mills, Inc., at Lufkin, Tex.

✦ L. L. Lewis, vice-president in charge of engineering, Carrier Corp., Syracuse, N. Y., and one of the early pioneers in air conditioning, was elected

president of the American Society of Refrigerating Engineers in December.

✦ FOSTER DEE SNELL is president of the Alumni Association of the Graduate Schools of Columbia.

M. B. Gentry

✦ M. B. GENTRY is named vice-president of Freeport Sulphur Co. He joined the organization in 1935 as assistant to Langbourne M. Williams, Jr., president, and has been in charge of foreign sulphur sales and of sales of the Cuban-American Manganese Corp., a Freeport subsidiary, which developed a new flotation process to concentrate low-grade Cuban manganese ores.

Herbert J. Krase

✦ HERBERT J. KRASE, assistant director of research and patent attorney for Monsanto Chemical Co.'s phosphate division, has been transferred from Monsanto plant at Anniston, Ala., to Dayton, Ohio, where he assumed new duties at the company's central research laboratories. Mr. Krase has taken charge of all patent work for the central research laboratories as well as for the phosphate division.

✦ HARVEY H. GRICE, a candidate for the Ph.D. degree in chemical engineering at Ohio State University, has been awarded the Bloede Scholarship of the Chemists' Club, New York City,

for the school year 1940–41. This scholarship which was founded in 1916 through the generosity of the late Dr. Victor G. Bloede, was originally given every year. Appointments are now to be made in alternate years. Mr. Grice received his bachelor of chemical engineering and master of science degrees from Ohio State in 1937 and 1938 respectively. He served as a graduate assistant in the department of chemical engineering from 1937 until his appointment to the Bloede Scholarship. His industrial experience has included work in both the operating and research departments of Diamond Crystal Salt Division, General Foods Corp., St. Clair, Mich.

OBITUARY

✦ M. L. DAVIES, former president of the Standard Chemical Co., Ltd., died at his home, December 17, after a long illness. He was 75 years of age. Born in Liverpool, England, Mr. Davies was manager of the Liverpool works of James Muspratt & Sons before coming to the United States in 1899. He was appointed general manager of the North American Chemical Co. at Bay City, Mich., that year and held the post until 1913, when he went to Toronto as general manager of the Standard Chemical Co. He was appointed vice president of the company in the same year and president in 1924. He retired in 1939 as a result of ill health, but remained a director of the company.

✦ AUGUSTUS EUGENE STALEY, SR., founder of A. E. Staley Mfg. Co., Decatur, Ill., and a pioneer in the corn and soybean processing industries, died December 26 at his winter home in Miami, Fla. He was 73 years of age. He was born in Julian, N. C., and in his youth was a salesman of tobacco and groceries. He noticed the great demand for starch and started his own starch packing plant. In 1909 he purchased the Wellington Starch Co. at Decatur, Ill., and for many years starch was the chief product. Later he became interested in soybeans and encouraged Illinois farmers to plant the crop. Mr. Staley served as president of the Staley company until a few years ago when he became chairman of the board, his son, A. E. Staley, Jr., becoming president.

✦ GEORGE HATHAWAY TABER, retired vice president of Gulf Oil Corp., died at his home in Pittsburgh on December 10. Mr. Taber was born Jan. 20, 1859 in Fairhaven, near New Bedford, Mass. He entered the petroleum refining industry in 1882 at the Queen County Oil Works, in Brooklyn, one of the units of the Standard Oil Co. While there he was responsible for the ultimately successful use of plate and frame filter presses in dewaxing chilled wax distillates including the application of the hydraulic ram. He retired from active business in 1928.

DR. HOLMES ELECTED PRESIDENT OF A.C.S. FOR 1942

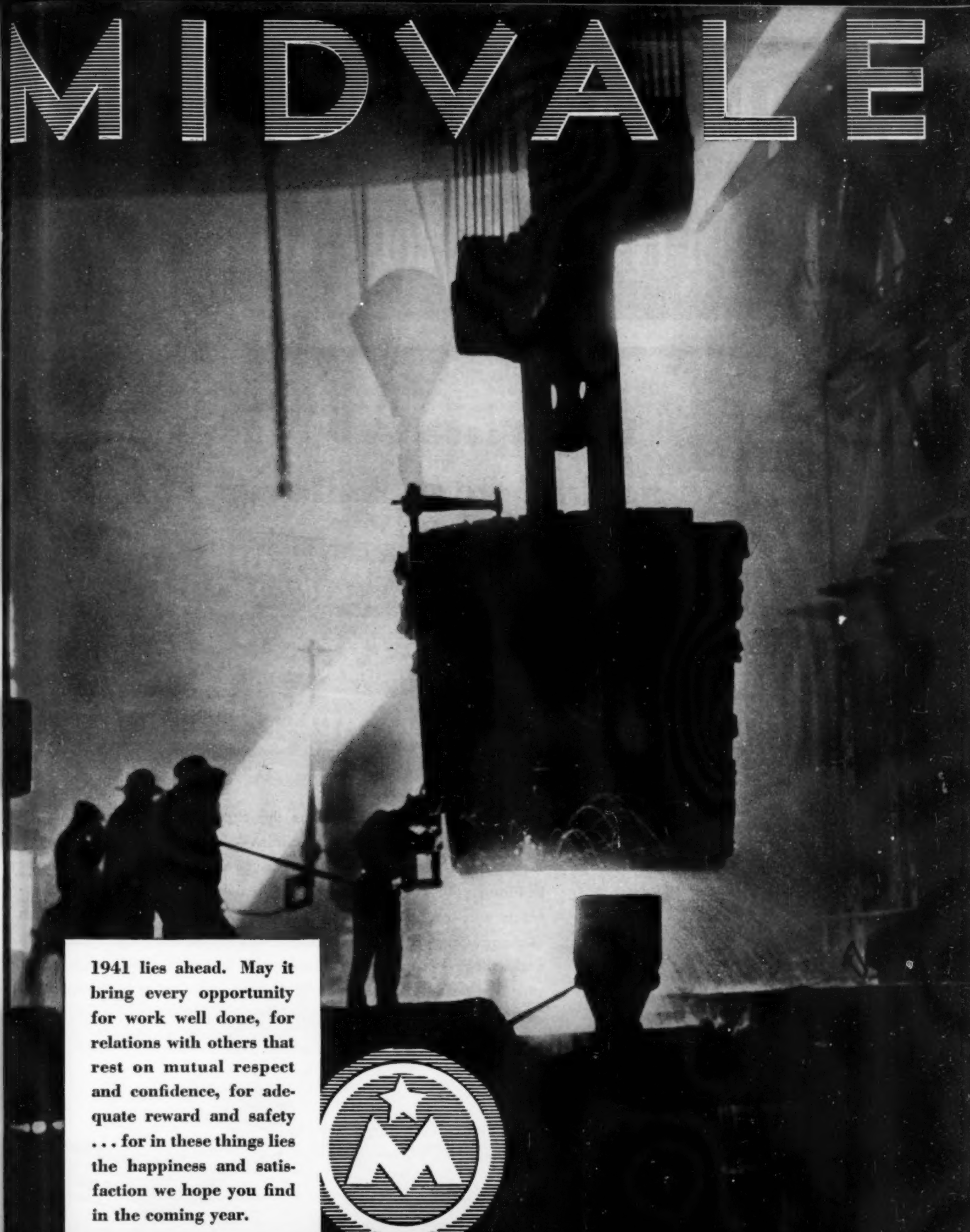
Dr. Harry N. Holmes, head of the department of chemistry at Oberlin College, has been elected president of the American Chemical Society for 1942 and took office as president-elect on Jan. 1. As a result of the national poll of the Society's members, other officers elected include: Directors—Dr. Williard H. Dow, president of the Dow Chemical Co.; Dr. Robert E. Wilson, president of the Pan-American Petroleum and Transport Co.; and Prof. Roger Adams, head of the chemistry department of the University of Illinois. Councilors-at-large—Dr. William M. Clark, De Lamar professor of physiological chemistry at the Johns Hopkins University; Dean Joel H. Hildebrand of the College of Letters and Science of the University of California; Dr. G. E. F. Lundell, chief chemist of the National Bureau of Standards; and Dr. Charles A. Thomas, director of research of Thomas and Hochwalt Laboratories of Monsanto Chemical Co.

Dr. Harry N. Holmes

On Jan. 1, Prof. William Lloyd Evans, head of the department of chemistry at Ohio State University assumed the office of president for the current year, succeeding Dean Samuel Coville Lind of the University of Minnesota.

DCAT WILL HOLD ANNUAL DINNER MARCH 13

John J. Toohy, sales manager of E. R. Squibb & Sons and chairman of the Drug, Chemical and Allied Trades Section of the New York Board of Trade has announced that the 16th Annual Drug, Chemical and Allied Trades Dinner will be held on Thursday evening, March 13 at the Waldorf-Astoria Hotel, New York. Rudolf F. Berls of McKesson and Robbins, Inc. is chairman of the reception committee aided by Victor E. Williams of Monsanto Chemical Co.


MIDVALE
1941 lies ahead. May it bring every opportunity for work well done, for relations with others that rest on mutual respect and confidence, for adequate reward and safety . . . for in these things lies the happiness and satisfaction we hope you find in the coming year.
THE MIDVALE COMPANY · NICETOWN · PHILADELPHIA, PA.

Diffusion Is Subject of A.C.S. Meet

Chem & Met MEETINGS & CONVENTIONS

DIFFUSION as a Basis of Unit Operations was the subject of a 2-day meeting of the American Chemical Society's Division of Industrial & Engineering Chemistry held at Princeton University December 27 and 28. Ten papers were read before the meeting and two were presented by title only. Dr. C. C. Furnas of Yale University was chairman of the symposium committee and Prof. J. C. Elgin of Princeton headed the committee on local arrangements.

Dr. George Gallup, director of the American Institute of Public Opinion, was the guest speaker at a dinner December 27 at which S. D. Kirkpatrick, editor of *Chem. & Met.* officiated as toastmaster. Another feature of the meeting was a round-table discussion held Saturday morning.

Following are abstracts of some of the papers presented:

Agitation Coefficients—Designers of agitating machinery used for the dissolution of solids in liquids in the steel, plastics, oil and sugar refining, rubber, lacquer and other industries will be able to predict accurately the results to be obtained with their equipment by applying a new equation derived by Dr. Arthur W. Hixson, professor of chemical engineering, and Sidney J. Baum, graduate fellow, at Columbia University.

"We have sought to eliminate experimentation with full-size equipment by making it possible to apply, with assurance of success, data derived from experimentation with models to the operating machinery," Dr. Hixson and Mr. Baum declared in their paper.

The equation proposed is a simplification of the Cube Root Law discovered at Columbia in 1930 by Dr. Hixson and Joyce H. Crowell, a graduate student in chemical engineering at the time. The complexities of this law limited its practical application; so an approximate, integrated form has been derived which can be used to determine mass transfer data for several liquid-solid combinations in a series of dimensionally similar agitators.

The Columbia chemists experimented with vessels varying from six inches in diameter to commercial size. They discovered that for any particular liquid-solid system having the same temperature, a logarithmic plot of the dissolution constant, versus the product of the speed and size factor, yields a straight line. Then they found that the results for several systems could be correlated on a dimensional basis.

By applying this equation to the data derived from experimentation with models, it was possible to predict accurately the dimensions of the operating equipment as well as the completeness of the mixing job it would do, the time that would be required for the mixing and the amount of power that would be consumed in the process.

Bubbles in Oil—When carbon dioxide escapes from a freshly opened container of carbonated beverage, it typifies a problem of behavior of gases in liquids of great importance to the chemical industry, and especially to the petroleum industry. Aspects of this problem were investigated and reported at the Symposium by Drs. H. B. Hatcher and B. H. Sage of the California Institute of Technology.

Directed primarily toward a study of bubbles from oils in which there was a tendency for the escape of gaseous hydrocarbons, the investigation showed that small bubbles cannot exist in liquids which are only slightly supersaturated. However, bubbles of small size become stable when the tendency for the escape of the gaseous hydrocarbons becomes sufficiently great; that is, when the liquid becomes more supersaturated.

It was found that agitation or turbulence is of nearly controlling importance in determining the degree of supersaturation attainable in oils in which gas is dissolved. Rapid agitation results in the formation of bubbles with relatively little supersaturation while non-agitated liquids may be supersaturated to a marked extent.

Agitation is also of importance in promoting the solution of gases in oils with which they are in contact. The influence of agitation is nearly as great in the case of the escape as in the solution of the gases.

The rate of solution, however, is influenced by the diffusion rate of the gas in the liquid as well as by the amount of agitation. Measurements of these diffusion rates for normal butane in a heavy oil were made over a range of concentrations. The results indicated that the diffusion rates of hydrocarbons in liquids are influenced to a reasonable extent by the nature of the liquid in question.

Loss of Plasticizer—Plastic products commonly used in the home and for clothing accessories would become brittle and break under the slightest strain if the liquid softener added to their composition were permitted to escape, according to Dr. H. A. Liebhafsky of the General Electric Research Laboratory, Schenectady, N. Y.

To learn how to prevent the loss of this softener or "plasticizer," Dr. Liebhafsky conducted a study of the conditions under which it leaves the polyvinyl plastics.

"Until a plasticizer is added," Dr. Liebhafsky explained, "the polyvinyl chloride has little practical use. However, when a softener is added the clear, white resin becomes highly flexible and can conveniently be molded into many shapes, making it useful for many purposes.

A loss of plasticizer can occur in various ways. Simple heating in air will cause only slight losses. Heating in a rapidly stirred liquid, or in a liquid that reacts with the plasticizer, will accelerate the losses. When heating in sufficiently high vacua so that plasticizer molecules, having evaporated, will not return to the plastic surfaces, the rate at which plasticizer diffuses to the surfaces may be measured.

Measurements were made at temperatures varying between 110 and 155 deg. C. Tricresyl phosphate, dibutyl phthalate and dibenzyl sebacate were the three plasticizers used for the experiments.

Summarizing the work, Dr. Liebhaf-

CALENDAR

FEB. 17-20, 1941, **Technical Association of the Pulp and Paper Industry, annual meeting, Hotel Roosevelt, New York.**

APRIL 7-11, 1941, **American Chemical Society, St. Louis, Mo.**

APRIL 16-19, 1941, **Electrochemical Society, annual meeting, Cleveland, Ohio.**

MAY 19-21, 1941, **American Institute of Chemical Engineers, Chicago.**

MAY 19-23, 1941, **American Petroleum Institute, mid-year meeting, Fort Worth, Texas.**

sky said: "It became apparent that physical, rather than chemical, forces act between the polyvinyl chloride and the plasticizer since all three plasticizers diffused out of the polyvinyl chloride plastics at about the same rate."

The rate of this diffusion decreases rapidly with the concentration of plasticizer, so that a plastic tends to seal itself against further loss when the plasticizer is taken out. This is fortunate because it tends to preserve the softness and flexibility of the plastic, Dr. Liebhafsky declared. The plastic was found to shrink as the plasticizer disappeared. The relative shrinkage was about the same in all directions and the amount of shrinkage was equal to the volume of plasticizer lost.

Heat-Material Transfer — Many industries employ the chemical process whereby both heat and material are exchanged between a liquid and a gas placed in direct contact with each other. Dr. Walter I. Barnet of the Federal Power Commission, Washington, D. C., and Dr. Kenneth A. Kobe of the University of Washington studied the relationship between the rates at which heat and material can simultaneously pass directly between a gas and a liquid. They found that, between air and water, a definite relationship exists between the diffusion of heat and the diffusion of water vapor.

Conditions in the air stream determined the rates of transfer, Dr. Barnet reported. Such things as temperature and velocity of the water stream had no effect.

The results of this work corroborate those obtained by previous investigators and strengthen the conclusion that a definite relationship exists between the two types of diffusional processes, heat transfer, and material transfer.

An example of the importance of this conclusion is its use in the estimation of the efficiency of equipment that is to be employed for material transfer under conditions similar to those existing during the prior use for heat transfer.

A. P. I. CONVENTION

At the annual meeting of the American Petroleum Institute, held in Chicago last November, a number of papers were presented which are of interest to chemical engineers. Among them are the following:

Synthetic Chemicals — Manufacture of synthetic chemicals from petroleum and natural gas has been one of the major developments in the chemical industry during the past decade. As an example, Shell Chemical Co.'s production of ammonia has increased from 4,500 tons in 1931 to 27,000 tons in 1939; of solvents from 90,000 lb. to 57,000,000 lb. in the same period, according to L. Rosenstein of that company. A continually increasing variety of chemicals of exceptionally high purity is being made available at constantly decreasing cost, from cheap

raw materials whose supply is stable, abundant and remarkably adaptable. Alcohols, ketones and esters made from refinery gases that formerly were used only as furnace fuel now are known quite well to chemical markets. Many new products, now produced on laboratory and pilot-plant scale by Shell Development Co. in due course will join them. Among these are unsaturated alcohols and chlorides, glycerine and its derivatives, and butadiene.

The entrance of the petroleum industry into the field of synthetic chemicals has had a profound influence upon the development of synthetic gasolines; thus the development of isooctane was associated closely with that of secondary butyl alcohol. Other similarly close relationships may be expected as petroleum chemicals play an increasingly important part in the economics of the industry.

Lecithin in Gasoline—Lecithin, obtained from soybeans is a phosphatide found to be effective in improving leaded and unleaded gasoline quality and stability, according to H. V. Rees, W. S. Quimby and J. C. D. Osterhout of The Texas Co. It has little effect on initial or dark storage color, but markedly reduces decolorization as well as haze and deposit formation when exposed to sunlight, as in gasoline-dispensing pumps. Its use results in decreased corrosion of storage-tank bottoms and of galvanized drums, particularly those containing highly leaded aviation gasolines in which the formation of zinc oxide deposits often require filtration prior to consumption. Reduced aluminum corrosion in aviation-gasoline tanks due to moisture condensation also was found. Dosages required range from 1 lb. to 15 lb. per 1,000 bbl.

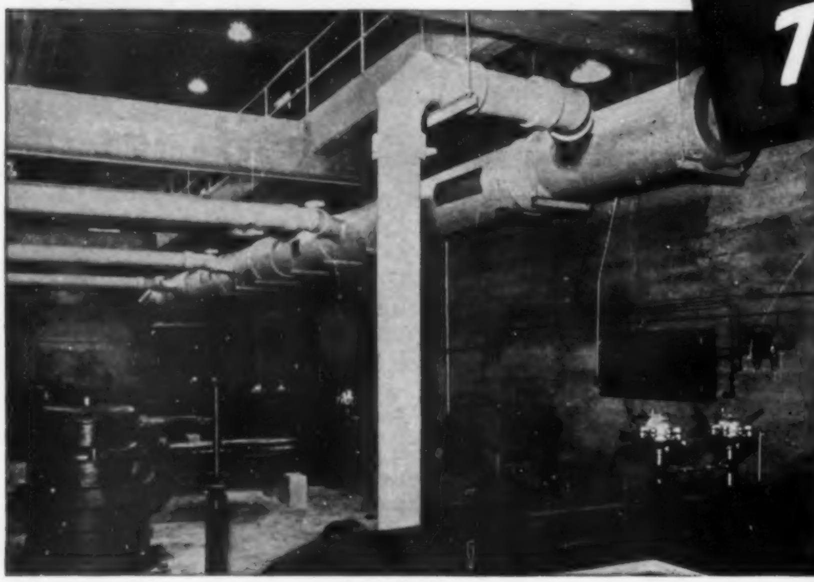
Emulsion De-Oiling—A. H. Schutte of the Lummus Co. described a new process for de-oiling crystalling waxes. Normally, a wax stock is cooled until the wax solidifies; then it is filtered. But the system is not freely separable because the wax crystals impede the flow of oil and the oil adheres to them.

By the new process the oily wax is charged to an emulsifier together with a small amount of compressed air; then water is added. An emulsion is formed with water as the continuous phase. A special filtering-type basket centrifugal jacketed for temperature control is used to separate the emulsion and the resultant filter cake is finely crystalline, porous, and may be washed readily with large volumes of water.

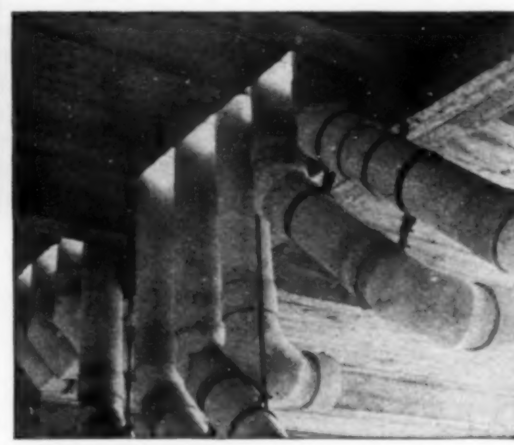
Commercial installations of 400 and 700 bbl. per day capacities are now in operation.

Gas Scrubbing — Recent developments of the Pease-Anthony scrubber were described before the annual meeting of the A.S.M.E. held in New York December 4-6, by R. V. Kleinschmidt and A. W. Anthony. Among the installations discussed were the scrubbing of boiler flue gases for fly-ash removal, recovery and sale of SO_2, treatment of tar fog and cleaning and cooling of blast-furnace gas.

If you'd like to cut your vent-pipe costs— BETTER TRY TRANSITE!



SEWAGE-PLANT GASES have little effect on Transite "S" Pipe. Made of asbestos and cement, this durable material is highly resistant to all forms of corrosion. This installation is in the Des Moines, Iowa, Sewage-Disposal Plant.

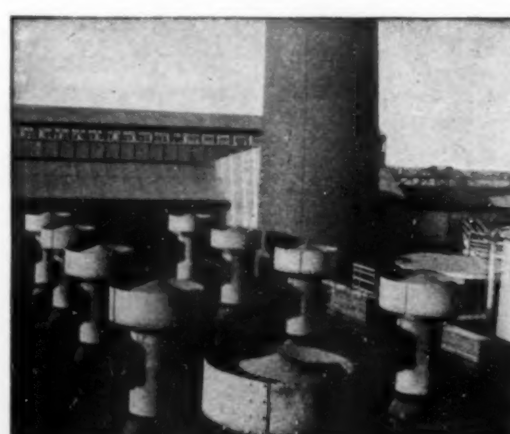


LABORATORY FUMES have been carried in this Transite "S" Pipe system for the past 2 years. The wide range of fittings available makes possible rapid installation even in cramped working quarters.

Time after time, J-M Transite "S" Pipe has proved its ability to add longer life and lower maintenance to industrial venting systems

IN SCORES of plants all over the country, J-M Transite "S" Pipe is setting new standards for venting efficiency and long life. And for good reasons. An asbestos-cement product, this material is custom-made for industrial venting. Uniformly strong and durable, it is highly resistant to most commonly vented fumes, gases, vapors and dust.

But that's not the whole story. Transite "S" Pipe is supplied in long, 13-foot lengths, with a complete line of fittings. It can be readily cut or sawed with ordinary tools . . . easily adapted to any structural needs. Even in restricted working areas, jobs are finished quickly at low cost. For full details, write for brochure DS-336. Johns-Manville, 22 East 40th Street, New York, N. Y.



WEATHER ON THE OUTSIDE, corrosive salt fumes on the inside, make a tough combination. Yet these Transite Ventilators and Transite "S" Pipe lines at the Hutchinson, Kansas, plant of the Morton Salt Co. are virtually unaffected.

JM JOHNS-MANVILLE

TRANSITE "S" PIPE

For Efficient, Low-Cost Venting Systems

New Titles, Editions and Authors

Chem & Met BOOKSHELF

SELLING TO INDUSTRY

SALES ENGINEERING. By *Bernard Lester*. Published by John Wiley and Sons, New York, N. Y., 200 pages. Price $2.

Reviewed by *Lloyd C. Cooley*.

THE BOOK is a thorough, well arranged treatise containing much value for beginners and plenty of useful reminders for older technical salesmen to review. The subject is covered broadly from many angles and at the same time contains plenty of specific examples and recommendations. The chemical engineer will find few references to his field of technology but will recognize that the principles apply definitely without exception. The author's gem is, "Getting on the job personally, determining what should be done promptly, and getting it done with emergency dispatch are the essentials to follow. More friends and better friends are made through trouble than in most any other way. The plant manager is always approachable if you hold an answer to his troubles. The barometer of customer confidence becomes immediately sensitive in time of trouble; its favorable reading depends upon prompt and satisfying performance."

ELEKTROCHEMISCHES PRAKTIKUM. Fifth Edition. By *Erich Müller*. Published by Theodor Steinkopff, Dresden. 276 pages. Price, RM 11.25.

Reviewed by *H. Jermain Creighton*

"ELEKTROCHEMISCHES PRAKTIKUM" in the new edition has the same sequence of topics and substantially the same size and contents as the last. The only important addition is an experiment on chromium plating. The first section of the book is devoted to a discussion of sources of electrical energy required in the electrochemical laboratory, electric circuits, and various forms of apparatus employed. This is followed by a special section containing seventy-two experiments on Ohm's law and polarization potential, Faraday's laws, electrolytic conductance, electromotive force, electroanalysis, electroplating, preparation of inorganic compounds, preparation of organic compounds, electrolysis of molten salts, and electrothermic processes. Detailed accounts of the apparatus and the method of manipulation employed in each experiment are given, and the underlying theory is briefly discussed. Most of the experiments are accompanied by a complete wiring diagram, and frequently related fields of investigation are indicated and tables are inserted to illustrate the effective method of tabulating experimental data. The section on electrochemical reduction of organic compounds is excellent, but that on the oxidation of such substances is weak. This is unfortunate in view of the ever-growing interest in electro-organic chemistry.

The author is to be congratulated not only on his important contribution to the teaching of experimental electrochemistry, but also on his clear and succinct presentation. The frequency with which new editions of his book have been published during the past twenty-eight years, as well as its translation into French and Spanish, is indicative of its merit. While it is unfortunate that as yet there is no English translation of this excellent and unique laboratory manual of electrochemistry it will continue to win new friends in this country. Teachers of electrochemistry should have it at hand.

MINERALS YEARBOOK 1940. Published by U. S. Bureau of Mines. Distributed by Superintendent of Documents, Government Printing Office, Washington, D. C. 1514 pages; $2 (clothbound).

THIS IS the Government's statistical review of the mineral industry of the United States. It gives valuable and complete figures on production, imports and exports with a chapter discussing important recent events with respect to each of about 50 mineral commodities.

Since chemical process industry is the largest customer of mining and mineral industries, this volume is really a necessary item for any technical library of consequence.

TECHNICAL DRAFTING. By *Charles H. Schumann*. Published by Harper & Brothers, New York, N. Y. 793 pages. Price $3.50.

ENGINEERS are not necessarily first class draftsmen, but they frequently are required to express and clarify ideas by means of drawings and sketches. And they also need an ability to understand the drawings and sketches made by others. Therefore, sound engineering training should include study and practice of the subject which Prof. Schumann calls "The keystone of the profession."

There are available many books on drafting, but this one seems to be the first which not only aims to give the engineering student a basic training but also subsequent practice in his particular chosen field. The first of the book's two parts, Elements of Engineering Drafting, presents clear descriptions and directions, numerous illustrations and problems. The second part, Professional Drafting, not only contains chapters on mechanical, civil, chemical, electrical and industrial engineering drafting, but it also has chapters on engineering graphs, machine elements, welding, architectural drafting as well as several other subjects of interest and value to the engineer. An adequate index to the text is also included.

A thoroughly workman-like job has been done on the book. The material included, its preparation and its presentation will undoubtedly result in success for the author's aim to produce a volume which would be a comprehensive textbook as well as a professional reference book.

PHYSICAL CHEMISTRY

AN INTRODUCTION TO THE KINETIC THEORY OF GASES. By *Sir James Jeans*. Published by The University Press, Cambridge. Available from The Macmillan Company, New York, N. Y. 311 pages. Price $3.50.

Reviewed by *G. F. Kinney*

THE CLASSICAL kinetic theory of gases presented in a straightforward manner. The author states in his preface "I have intended that the present book shall provide such knowledge of the Kinetic Theory as is required by the average serious student of physics and physical chemistry. . . . Inevitably the book covers a good deal of the same ground as my earlier book, *The Dynamical Theory of Gases*, but it is covered in a simpler and more physical manner."

Gas viscosity, heat conductivity, diffusion, heat capacity, etc., are all studied in a very thorough way, and where possible experimental corroboration of kinetic theory deductions included. The viewpoint throughout is strictly the classical Newtonian, but the author is careful to indicate places where quantum mechanics has been useful in extending the work.

The book will certainly become a standard text on kinetic theory, for in spite of its subject matter it is quite readable. The reviewer would have found it even more readable if a nomenclature table had been included, but the omission can hardly be considered a defect in such an uncompromising treatise that presents its subject so powerfully.

PHYSICAL CHEMISTRY OF HIGH POLYMERIC SYSTEMS. By *H. Mark*. Translated by *K. Sinclair*, revised by *J. E. Woods*. Published by Interscience Publishers, Inc., New York, N. Y. 345 pages. Price $6.50.

SECOND of a series on "High Polymers," Professor Mark's monograph treats the question "What physical and chemical methods have proved necessary and effective in the preparation, purification, examination and elucidation of the high polymers?" His study and

comprehensive review of modern concepts have resulted in this new book—a real contribution not only to the literature of high polymers but also to advanced physical chemistry.

The subject matter of the volume is divided into seven chapters of which the first six treat such topics as geometry and internal motions of molecules, primary and secondary valences, crystal forces and lattice forces, molecular arrangement in liquids, minute crystals, and the behavior of mixtures. And in the concluding chapter, for approximately one-tenth of the book's pages, the author discusses kinetic phenomena in high polymer chemistry, including the phenomena of diffusion and the formation and degradation of long chain molecules.

So fundamental are the theories and data presented, one might consider that the volume should have been first instead of second in the Series.

A TEXTBOOK OF FIRE ASSAYING. Third edition. By *Edward E. Bugbee.* Published by John Wiley and Sons, New York, N. Y. 314 pages. Price $3.

Reviewed by *Jas. Lewis Howe.*

It is almost thirty years since the students at the Massachusetts Institute of Technology began using Professor Bugbee's mimeographed notes in their assaying course. These notes grew into a small volume, and this third edition of the book embodies not only the improvements suggested by more than a score of years of practical student supervision in assaying, but the results of research in the author's laboratory, and also methods relating to the assay of black sands, cyanide pulp and tailings, and very lean platinum ores. This last topic includes microtitration of small amounts of the platinum metals in cupellation beads. There is also a new chapter dealing with 'the special problems of plant or commercial assaying', entitled "Practical Assaying," which cannot fail to be of value to advanced students and graduates. While the book is practical, it is thoroughly scientific, and the author has fully succeeded in attaining his aim of "avoidance of the cookbook style."

The book is excellently gotten up, is remarkably free from typographical errors, and has a very complete index.

CHEMICAL SPECIES. By *Jean Timmermanns.* Translated by *Ralph E. Oesper.* Published by the Chemical Publishing Co., New York, N. Y. 177 pages. Price $4.

Reviewed by *F. C. Nachod*

Dr. Timmermanns wrote "La Notion D'Espèce en Chemie" in 1928. Now, 12 years later, after being revised, the manuscript appears in English, thanks to Dr. Oesper's excellent translation. The little book will doubtlessly find many American and English friends.

Four main parts form the content: Definition of chemical systems; pure materials; determination of physical constants; and the way to find in the

literature the best method of purification and the most probable value of constants of pure materials.

Students as well as men in the technical field will welcome this book. It is meant to brush up chemical doctrines and rules from a physico-chemical aspect and to bring clarity to many problems. It will teach the reader to be critical and will show him not to believe that all "constants" he finds in handbooks and tables are truly reliable. Practical examples and applications are found throughout the book. The reviewer was particularly pleased with the simple though elegant treatment of the theory of least squares. There is no index in this book, but there is no necessity for one because it reads like an exciting novel.

SILICOSIS—Proceedings of the International Conference held in Geneva from August 29 to September 9, 1938. Published by International Labour Office, Geneva, Switzerland. Available from Washington Branch, International Labor Office, 734 Jackson Place, Washington, D. C. 223 pages. Price $1.25.

THIS IS essentially a report of the proceedings of the conference at Geneva in 1938. However, it is supplemented by 14 appendixes which give special technical interpretation of various biochemical, pathological, and engineering features of the problem. Taken altogether, these appendixes are an excellent composite reference to present knowledge as interpreted by experts of international standing.

REGULATIONS FOR TRANSPORTATION OF EXPLOSIVES AND OTHER DANGEROUS ARTICLES BY LAND AND WATER IN RAIL FREIGHT, EXPRESS, AND BAGGAGE SERVICES AND BY MOTOR VEHICLE (HIGHWAY), AND WATER, INCLUDING SPECIFICATIONS FOR SHIPPING CONTAINERS. Published by Interstate Commerce Commission. Distributed by Superintendent of Documents, Government Printing Office, Washington, D. C. 219 pages. Price 40 cents.

Reviewed by *R. S. McBride.*

THIS new set of regulations prescribes container, packaging, labeling, loading, and handling requirements for a wide variety of commodities. It is the complete revision of I. C. C. requirements which has been under way for several years.

Not only those engaged actually in shipping or handling potentially dangerous commodities need this book. Every chemical engineer engaged in development, design, or plant operation can profit by a study of its contents. The rules presented enable the technical man to understand better the necessary restrictions on handling and use of many commodities while in the plant as well as while in interstate commerce.

The volume can be cordially recommended as a manual of good practice and a guide to safety. It is not a book which one will read; but it is one to which frequent reference can be made with great profit.

CURRENT LITERATURE ABSTRACTS

CORROSION PREVENTION

Among the synthetic resins which are serving to protect metals from aggressive chemicals are several phenoplasts and polyvinyl chloride plastics, with some hydrocarbon high polymers as recent additions to the list. These plastics are sometimes used to replace instead of to protect metal, e.g. in condenser coils. Some applications of thermoplastics to corrosion prevention are:

1. An iron-jacketed double coil condenser with polyvinyl chloride coils and a polyvinyl chloride sheet lining in the jacket.
2. A wrought iron four-paddle stirrer with polyvinyl chloride shrunk on the stirrer arms.
3. Pipe lined with a hydrocarbon high polymer resin.
4. Storage tank, same kind of lining.
5. Pan for a spray cooler, same kind of lining.

Resin foils for lining pipe or containers should not be less than 0.4 mm. thick and should preferably be about 1 mm. thick if made of polyvinyl chloride, or 2 mm. thick if made of hydrocarbon high polymer resins. Good bonding of plastic to metal is obtained by using a plastic foil, without a solvent, as the adhesive.

Digest from "Using Thermoplastics for Corrosion Prevention in Containers and Pipelines," by Walter Krannich, *Chemische Fabrik* **13**, 233, 1940. (Published in Germany.)

PREPARATION OF BENZOIC ACID OF HIGH PURITY

In the *Journal of Research*, Dec. 1940, Frank W. Schwab and Edward Wichers describe (RP1351) the preparation of benzoic acid of extremely high purity.

For many years benzoic acid has been used as a standard substance in acidimetry and for the calibration of bomb calorimeters. Certified samples of the material have been issued by the Bureau since 1911. Recently, it became necessary to prepare some of the material of the highest practicable purity, primarily for a determination of the heat of combustion of the pure substance.

A number of methods for preparing pure benzoic acid were compared, both with respect to the degree of purity and the ease with which it could be attained. Simultaneously, a study was made of means for determining the purity of the substance. The methods adopted for determining purity were based on very precise determinations of the freezing range of the acid, and on measurements of the specific heat of the solid substance at temperatures closely approaching its melting point.

The methods of preparation which were studied were: purification of a commercial material, which was about 99.98 percent pure, by fractional distillation in vacuum; fractional freezing, and crystallization from solvents; and preparation from other substances by selected reactions. A purity of 99.999 mol percent was attained by each of three methods: Crystallization from benzene; fractional freezing; and hydrolysis of benzoyl chloride, purified by fractional distillation. Crystallization from water gave material 99.996 percent pure in the same number of steps that yielded the purer material by crystallization from benzene. The ready availability of pure water partly offsets the advantage of the more rapid purification from benzene. Hydrolysis of benzoyl chloride is rapid and easy but involves painstaking preliminary purification of the parent substance. Fractional freezing is a relatively simple and rapid method. The freezing point of benzoic acid is tentatively given as 122.36 deg. C. ±0.01 deg. C.

ADJUSTING PAPER MACHINE LOADS

Devices for increasing or decreasing the load on paper machine rolls have hitherto depended on lever systems which were difficult to lubricate and cumbersome to operate. Some have been more of a hindrance than a help in operating the machine. A new load control system utilizes pin bearings which eliminate nearly all the friction. The short lever arm has been reduced to less than an inch in length. By these and other improvements in design adequate power ratios are obtained with a simple, easily operated pair of levers permitting any load adjustment along a scale covering the desired range. The pin bearings permit high bearing pressures and such lubrication as they require is easily effected. They are excellently suited to the small oscillatory movements of the eccentric bolt in the lever system, giving high power transmission efficiency while adapting the load to every change in thickness of the paper, paperboard or felt passing between the rolls. As compared with pneumatic and hydraulic controls this improved lever system is simpler and more compact in construction, less expensive, easier to maintain and more dependable.

Digest from "Modern Load Control Devices on Paper Machines," by M. Heine, *Zellstoff und Papier* **20**, 212, 1940. (Published in Germany.)

VACUUM DRYING OF PIGMENTS

A kinetic study of vacuum drying has been made with lithopone, titanium dioxide, zinc sulphide, zinc oxide, white lead, Milori blue and ultramarine. These pigments were dried in layers 18-20 mm. thick under a medium vacuum (pressure 360-370 mm.) and a high vacuum (50-60 mm.) in comparison with samples dried at atmospheric pressure. Temperature readings were taken near the top, middle and bottom of the pigment layer by means of thermocouples. With the electrically heated vacuum oven operating at 120 deg. C. under atmospheric

pressure titanium dioxide (initial moisture content 51.6 percent, pigment layer 25 mm. thick) showed 98, 88 and 76 deg. C. as the top, middle and bottom temperatures in the pigment layer. Under 370 mm. pressure, pigment layer 18 mm. thick, initial moisture content 48.5 percent the corresponding temperatures were 90, 84 and 76 deg. C. In high vacuum (10 mm. pressure), with the pigment layer 22 mm. thick and initial moisture content 52.1 percent the top and bottom temperatures were 50 and 40 deg. C. respectively (no reading for the middle of the layer). Similar studies were made for all the pigments and curves were plotted to show relations of drying time to temperature (in the drying oven and in the pigment), pressure and initial moisture content. From the results the optimum conditions may be ascertained for achieving maximum heat exchange and most efficient drying for each pigment.

Digest from "Study of Vacuum Drying Processes," by P. G. Romankov, F. A. Dymarchuk and L. N. Davidenkova, *Org. Chem. Ind (USSR)* 7, 263, 1940. (Published in Russia.)

TEXTILE FINISHING MACHINES

IN AIR jet driers for drying fabrics there must be effective "scrubbing" contact between the air and the damp cloth, since the conditions favoring efficient drying are essentially similar to those favoring efficient heat transfer. Small closely spaced high speed air jets have been found effective, and since the cloth needs some support against the jets there is an added advantage in a set of equally spaced jets playing against the opposite face of the fabric. The Spooner vertical drier is one of the simplest air jet machines. A more elaborate drier, designed especially for gentle but efficient handling of delicate fabrics, is the Proctor multipass Airlay drier. The cloth is supported on the flat cork faces of poles which are carried by conveyor chains in a series of nearly vertical passes. This drier gives large output in relatively small space. Pin stenters, which were obsolescent until revived by demands for preshrunk fabrics and for dimensional control in rayon manufacture, are now made with several ingenious mechanical aids including close-jet heaters. Automatic guides and batchers also serve to increase output. A particularly helpful feature, recently introduced, is electric batching with the aid of a small motor having a series characteristic instead of a friction drive. With this device the cloth tension can be kept constant, instead of increasing as the batch builds up, and tension can be adjusted over a wide range according to the characteristics of the cloth. This feature is especially useful in batching preshrunk fabrics and all light silks and crepes, which must be protected from excessive tension.

Digest from "Modern Finishing Machinery," by K. S. Laurie, *Journal of the Society of Dyers and Colourists*, 56, 289, (1940). (Published in England.)

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Census Data. Preliminary reports giving general statistics on every industry division of the Census of Manufactures have been released. In some cases data on the quantity or value of individual commodities were not available when these preliminaries were issued just before the Holidays; but figures on number of establishments, salaries and wages, number of employees, total value of products, and a few other general figures have been released. Those requiring such data should address the Census of Manufactures, Washington, D. C., giving specifically the commodities on which production figures are needed. All commodity details are expected to be released during January.

Tungsten Deposits of the Atolia District, San Bernardino and Kern Counties, California, by Dwight M. Lemmon and John V. N. Dorr, 2d. U. S. Geological Survey, Bulletin 922-H; 25 cents.

Antimony Deposits of a Part of the Yellow Pine District Valley County, Idaho, by Donald E. White. U. S. Geological Survey, Bulletin 922-I; 30 cents.

Publications on Electric Batteries and Standard Cells. The National Bureau of Standards has recently issued their Letter Circular 610, listing publications by their staff and references to other sources of information on electric batteries and standard cells; mimeographed.

Publications and Detergents and Related Subjects. National Bureau of Standards, Letter Circular 608; mimeographed.

List of Simplified Practice Recommendations, Revised to October 15, 1940. National Bureau of Standards, Letter Circular 612; mimeographed.

A Survey of Humidities in Residences. National Bureau of Standards. Building Materials & Structure Reports No. 56; 10 cents.

Etching of Designs and Lettering on Metals. National Bureau of Standards, Letter Circular 616; mimeographed.

Statistics on Distilled Spirits and Rectified Spirits and Wines. Fiscal Year Ended June 30, 1940. Bureau of Internal Revenue, Alcohol Tax Unit; mimeographed.

Annual Report of the Board of Regents of the Smithsonian Institution, Fiscal Year ending June 30, 1939. Smithsonian Institution; $1.50 per clothbound copy of 567 pages.

Official Register 1940. The annual volume giving a complete list of all persons occupying administrative and supervisory positions in the legislative, executive, and judicial branches of the Government; $1 per clothbound copy.

Fed. Specification UU-P-264. Concrete-curing paper; 5 cents.

Federal Specification KK-L-136a. Leather; Artificial (Upholstery); 5 cents.

Specifications for Welding, Part 1—General, for Vessels of the United States Navy. Navy Department, Bureau of Ships; 15 cents.

Specifications for Riveting, Part 1—Steel Construction, for Vessels of the United States Navy. Navy Department, Bureau of Ships; 15 cents.

Strength of Soft-Soldered Joints in Copper Tubing, by Arthur R. Maupin and William H. Swanger. National Bureau of Standards, Building Materials & Structures Report 58; 10 cents.

Regain of Mercerized Cotton Yarns. Mimeographed preliminary specification submitted for acceptance of the industry. National Bureau of Standards, TS-2969; mimeographed.

Measurements of Compressibility of Consolidated Oil-Bearing Sandstones, by Charles B. Carpenter and George B. Spencer. Bureau of Mines, Report of Investigations 3540; mimeographed.

A Method for Determining the Water Content of Oil Sands, by D. B. Taliaferro and G. B. Spencer. Bureau of Mines, Report of Investigations 3535; mimeographed.

Production, Employment, and Output Per Man in Gypsum Mining, by Robinson Newcomb and Knute Peterson. Bureau of Mines, Information Circular 7134; mimeographed.

Effect of Hydrogen-Ion Concentration on the Growth of Hydrogen and Carbon Monoxide Bacteria, by G. W. Jones and G. S. Scott. Bureau of Mines, Information Circular 7133; mimeographed.

Glues, Gelatins and Related Products. U. S. Tariff Commission, Second Series Report No. 135; 25 cents.

Technical Manual—Hydrogen. War Department, TM 1-315; 10 cents.

Sources of Regional and Local Current Business Statistics, by Elma S. Moulton. A bibliography broken down by geographic subdivisions of the marketing of goods in the United States. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series No. 115; 30 cents.

The Structure of the American Economy, Part II—Toward Full Use of Resources, by Gardiner C. Means et al. National Resources Planning Board; 15 cents.

War and Its Effect on United States Imports. The U. S. Tariff Commission has issued a two-volume resume of recent foreign trade effects. Available from U. S. Tariff Commission, Washington, D. C.; processed.

Fats and Oils Data. Wholesale Prices of Fats and Oils in the United States: Index Numbers, 1910-1939, by Robert M. Walsh. U. S. Department of Agriculture, Technical Bulletin No. 737; 5 cents. The Fats and Oils Situation, December, 1940 issue. This document brings up-to-date the index numbers presented in Technical Bulletin 737. Available from Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C.; mimeographed.

Industrial Corporation Reports. The Federal Trade Commission has issued two additional reports in this series, namely: Rubber Products Manufacturing Corporations and Beet Sugar Refining Corporations. Available from Federal Trade Commission, Washington, D. C.

RECENT BOOKS and PAMPHLETS

Photo Relays, Their Theory and Application. By F. H. Shepard, Jr. Published by Allied Control Co., Inc., New York, N. Y. 25 pages. Price 25 cents. A technical discussion of photoelectric phenomena, amplifiers, glow discharge tubes, light sources, and applications of photo relays. The author points out that when used conservatively, the light operated relay and other photoelectric equipment possess a degree of reliability equal to that expected of other electrical and mechanical equipment.

Housing for Defense. By Miles L. Colean and The Housing Committee of the Twentieth Century Fund. Published by the Twentieth Century Fund, New York, N. Y. 198 pages. Price $1.50. Subtitled, "A Review of the Role of Housing in Relation to America's Defense, and a Program for Action," this report analyzes the basic elements of a national housing policy to meet the needs created by America's armament program. It finds that private industry has the capacity to provide the major part of the housing needs of our defense program, but an immediate plan of action for defense housing is necessary if we are to avoid the delays and mistakes that seriously crippled America's war efforts in 1917-18.

Welding Metallurgy. By O. H. Henry and G. E. Claussen. Published by American Welding Society, New York, N. Y. 359 pages. Price $1.50. Based on a series of lectures to familiarize members of the welding industry with the composition and structures of the metals commonly used, this textbook shows the effect of varied conditions of heat and stress in welding, explains heat treatment and illustrates how the knowledge of metallurgy can be used to control the welding processes.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Alloy Steel. Bethlehem Steel Co., Bethlehem, Pa.—Catalog 156—32-page book on Mayari R, this company's high strength, low-alloy, corrosion resisting steel, describing types of application, physical properties, special features, corrosion resistance, workability, etc.

Bearings. Boston Gear Works, Inc., North Quincy, Mass.—Catalog O-3—32-page stock list on Oilite bronze bearings and rough stock handled by this company, listing stock sizes on many recent additions. Includes 443 plain cylindrical bearings, 49 flanged and 23 thrust-type bearings, as well as cored bar, solid bar and plate stock forms.

Bearings. Link-Belt Co., Indianapolis, Ind.—Book No. 1775—84 pages on this company's new line of "Friction Fighter" ball and roller bearing units, with description and engineering data on each type and extensive engineering information to facilitate application.

Bearings. Stephens - Adamson Mfg. Co., Aurora, Ill.—Catalog 840—32 pages on this company's Sealmaster permanently sealed, prelubricated, self-aligning ball bearing units, describing available types, giving tables of load ratings and dimensions, and installation data.

Belting. Alexander Brothers, 406 North 3d St., Philadelphia, Pa.—Form A-116—32-page book on this company's leather belting and other leather products, describing features of these materials in question-and-answer form, covering various standard and special belts, and leather packings, with extensive tables of engineering data and tabulated useful information for belt design.

Blenders. H. K. Porter Co., 4915 Harrison St., Pittsburgh, Pa.—4-page leaflet describing this company's new double-cone blender for dry materials; also brief description of wet and dry mixers, ball mills, and laboratory jar mills made by this company.

Carbon Black. Godfrey L. Cabot, Inc., 77 Franklin St., Boston, Mass.—8-page leaflet on the measurement of blackness by methods developed by this company, with information on blackness of various carbon blacks.

Caustic Shipment. Columbia Chemical Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York, N. Y.—6-page leaflet describing this company's method of shipping caustic soda in tank cars, with information on types of cars employed and advantages of this type in avoiding crystallization of high concentrations and preventing contamination.

Chemicals. The Cowles Detergent Co., Heavy Chemical Dept., 7016 Euclid Ave., Cleveland, Ohio—6-page leaflet on this company's heavy chemicals, including anhydrous sodium metasilicate, pentahydrate sodium metasilicate and anhydrous sodium orthosilicate. Gives information on applications, advantages and types of package for each type.

Chemicals. Diamond Alkali Co., Standard Silicate Div., Pittsburgh, Pa.—16-page booklet on this company's silicate alkalis, giving properties and uses on each type, together with tables of useful information. Also leaflets describing properties of orthosilicate, metasilicate and "Supersilicate."

Chemicals. Koppers Co., Tar & Chemical Div., Koppers Bldg., Pittsburgh, Pa. —28-page booklet on this company's chemicals from coal including solvents, naphthalene and anthracene, tar acids, tar bases, benzene and toluene and other aromatics, etc. Gives condensed properties and uses.

Chemicals. Monsanto Chemical Co., St. Louis, Mo.—48-page booklet on chemicals made by this company's Phosphate Division, giving properties, strength, grades, containers and principal uses for each type. Also 20-page book describing the Aroclors, with tabulated and charted information on properties of various of these materials, together with data on applications in lubricants, coatings and in rubber and rubber substitutes.

Chemicals. The Quaker Oats Co., Technical Div., Board of Trade Bldg., Chicago, Ill.—12-page booklet on furfural as a selective solvent, with information on its use in refining petroleum oils, wood rosin and other materials. Gives information on properties, specifications, availability and costs.

Controllers. American Schaeffer & Budenberg Instrument Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn. —84-page catalog and textbook on controllers, covering this company's complete line of temperature and pressure controls including self- and pilot-operated types; also accessories.

Controllers. General Controls Co., 801 Allen Ave., Glendale, Calif.—Catalog 50 —48 pages covering this company's complete line of automatic pressure, flow and temperature controls, control valves, thermostats, relays, etc.

Dehydration. Carrier Corp., Syracuse, N. Y.—Bulletin 53B-4 and 53C-5—Describe construction and applications of this company's recently developed rotary type silica gel dehydrators for industrial and comfort conditioning of air.

Electrical Calculations. Ohmite Mfg. Co., 4835 Fluornoy St., Chicago, Ill.—New sliding scale calculator for electrical problems involving resistance, voltage, current and power, for solving any ohm's law problem with one setting of the slide. One side covers resistances to 1,000 ohms, the other side to 10 megohms. Also locates stock size resistors and rheostats for any problem. Send 10 cents for handling cost.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B6107—28 pages on motors for driving powerhouse auxiliaries, with selection information and data on construction and features of various types.

Electrical Equipment. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago, Ill.—Bulletin 31-C—Covers this company's complete line of unit type indoor bus supports, listing fittings making possible assembly of 50,000 different bus support combinations. Gives ampere capacities of standard bus shapes and physical data to facilitate making strength calculations.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-1542D, heavy-duty, direct-current motors, constant and adjustable speed; GEA-1868B, higher powered heavy-duty, direct-current motors; GEA-2964B, new small magnetic motor starter for up to 7½ hp. at 440 volt.

Equipment. The J. H. Day Co., Cincinnati, Ohio—Bulletin No. 353—16 pages on this company's chemical processing equipment including mixers and kneaders for dry, pasty and liquid materials, gyrating screens and sifters, paint mills, pot mills, etc.

Equipment. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: C-1100-B12, 6 pages on this company's centrifugal refrigeration systems for air conditioning and industrial applications; L-611-B11A, horizontal, two-stage reciprocating compressors; L-611-B12B, horizontal three-stage compressors; W-103-B4A, horizontal duplex side-pot steam pumps for refinery service.

Evaporative Condensers. Carrier Corp., Syracuse, N. Y.—Leaflet CR-162, 3, 5—Describe this company's Type 9S and 9Q6 and 7 evaporative condensers for use with refrigerating systems having capacities, respectively, of two tons or more, and 5 tons or more.

Feedwater Treatment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B6133—16-page book on this company's Akon feedwater treatment system, explaining in simple fashion what the problem is, and how Akon and the new Silimite silica-removing treatment eliminate various types of scale and oxygen, and reduce alkalinity, caustic embrittlement and corrosion.

Feedwater Treatment. Proportioneers, Inc., 9 Codding St., Providence, R. I.—Standard Method No. 122—15-page description of this company's complete chemical treating equipment for power plants, describes applications of various types.

Fittings. Taylor Forge & Pipe Works, P. O. Box 485, Chicago, Ill.—Catalog 401—216 pages on this company's complete line of seamless steel pipe fittings for welding; also forged steel flanges. Gives prices, dimensions and complete data on design, pressure and temperature ratings.

Gas Alarm. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Bulletin DT-2—Leaflet describing this company's new explosion-proof combustible gas alarm for automatic continuous sampling of atmospheres.

Glass Batch. Harbison-Walker Refractories Co., Pittsburgh, Pa.—4-page leaflet describing Babosil, a fluxing material for use in melting glass which is said materially to reduce average melting temperature and to eliminate seeds and cords, producing products of brilliant luster and exceptional clarity.

Grilles. Cornell Iron Works, 36th Ave. and 13th St., Long Island City, N. Y.—8-page catalog on this company's rolling grilles for closure of building openings, available in galvanized steel and various other metals and alloys.

Grinder. The Jeffrey Mfg. Co., Columbus, Ohio—Bulletin 749—4-page leaflet describing this company's screenings grinder for preliminary defibering work in pulp and paper mill service.

Heaters. Fansteel Metallurgical Corp., North Chicago, Ill.—Form Ta-4002—18-page book on this company's tantalum heaters for acid solutions, describing nine different types of heaters, heat exchangers and cooling units. Gives extensive information on corrosion resistance of tantalum, with engineering and heating capacity data and with other useful information.

Heaters. Emil E. Lungwitz, Terrill Road, Plainfield, N. J.—4-page leaflet describing this manufacturer's silent steam injectors for the heating of process liquids with direct steam; claimed to be completely noiseless despite large steam discharge capacity.

Instruments. Askania Regulator Co., 1603 South Michigan Ave., Chicago, Ill.—New booklet on stability in automatic control equipment, discussing causes and evils of "hunting" and showing how the difficulties are eliminated in this company's automatic control equipment for pressure, temperature, etc.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 15E—24 pages on this company's millivoltmeter type pyrometers, available in indicating, recording and controlling types.

Instruments. The Hays Corp., Michigan City, Ind.—First three of a series of educational engineering monographs on boiler room instrumentation and automatic combustion control, covering accuracy of steam pressure controlling; reason for operating automatic combustion control from steam pressure changes; adapting combustion control to under-feed stoker characteristics.

Instruments. The Jarrell-Ash Co., 165 Newbury St., Boston, Mass.—Bulletin SB.289—8-page bulletin of Adam Hilger Ltd., London, describing the Hilger photometric color comparator, also describing this company's photometric amplifier for use in conjunction with the color comparator, particularly on nearly white materials.

Instruments. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Catalog E-33A-503—27 pages on apparatus for checking thermocouple

pyrometers in the plant and laboratory, with information on various types and accessories.

Instruments. Mine Safety Appliance Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Bulletin TA-6—Leaflet describing this company's new power gage tester for testing gages (for compressed gas storage cylinders) for ability to withstand sudden applications of pressure.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Catalog 1101F—32 pages on this company's Selectray photoelectrically balanced electric thermometers and pyrometers in indicating, controlling and recording types.

Instruments. The Winslow Co., Newark, N. J.—Bulletin P-10-1—7-page leaflet describing this company's portable electrical instruments, including direct and alternating current voltmeters and millivoltmeters, ammeters and milliammeters. Also covers tachometers.

Insulation. Refractory & Insulation Corp., 381 Fourth Ave., New York, N. Y.—Bulletin I-64—6 pages on this company's laminated blanket insulation for flat or curved surfaces at temperatures up to 1,200 deg. F.; describes types and gives prices and information on selection and heat conductivity.

Materials Handling. Cleveland Tramrail Div., The Cleveland Crane & Engineering Co., Wickliffe, Ohio—8 pages on grabs of numerous types for overhead materials handling systems. Includes motorized types.

Materials Handling. Palmer Shile Co., 7100 West Jefferson Ave., Detroit, Mich.—4-page leaflet describing this company's barrel truck for handling of barrels and drums up to 1,000 lb. weight.

Metal Treating. Mathieson Alkali Works, 60 East 42d St., New York, N. Y.—44-page booklet on the use of ammonia in metal treating, with information on types of processes, ammonia in welding, application in various industries and with various metals, and properties and safe handling of ammonia.

Meters. American Meter Co., 60 East 42d St., New York, N. Y.—Catalog LPG-4—16 pages on this company's meters for liquefied petroleum gases, describing construction and testing of meters, handling and use of liquefied gases and specifications of various meter types.

Mixing. American Machine & Foundry Co., 511 Fifth Ave., New York, N. Y.—8-page catalog describing this company's new Type 340 Glen vertical planetary mixing machine, said to be the largest of this type (85-gal. bowl) ever constructed. Describes construction features, various types of agitators and bowls and also smaller mixers made by this company.

Paints. Paint Engineers, Inc., Hawthorne, N. J.—64-page Color and Standards Specification Book, covering industrial and structural maintenance, surface treatment, methods of cleaning and applying paint, and describing more than 50 primers, intermediary and final coats which are available from this company.

Plastics. Bakelite Corp., 30 East 42d St., New York, N. Y.—32-page book on Bakelite molding plastics, including phenolics, ureas, acetates and polystyrenes, with comparative information on various types and on various molding methods, descriptions of the several types, and tables of physical and electrical data.

Pumps. Quimby Pump Co., 340 Thomas St., Newark, N. J.—Bulletin S-203—8 pages on this company's gear-in-head type screw pumps with engineering and selection data, information on performance and construction and on numerous types and applications.

Refractories. The Ironton Fire Brick Co., Ironton, Ohio—Leaflet describing this company's Cavalier fire brick for intermediate heat duty, describing composition, properties and suggested applications.

Roofs. Republic Stamping & Enameling Co., Canton, Ohio—6-page leaflet describing corrugated porcelain enameled steel roofing and siding produced by this company. Illustrates typical applications which have been maintenance-free for varying periods of years.

Rubber Products. Hewitt Rubber Corp., Buffalo, N. Y.—36-page catalog on this company's rubber products for industry including air, acid, welding, water and steam hose, fire hose, sanitary hose, etc. Also 14-page catalog on hose for petroleum production and refining and 10-page catalog on hose for the petroleum products marketing industry.

Shaped Wire. Page Steel & Wire Div., American Chain & Cable Co., Monessen, Pa. — Bulletin DH-1226 — 12 pages on this company's special shaped wire, obtainable in a wide variety of cross sections in low- and high-carbon, stainless and chromium steels and ingot iron, giving analyses and physical property data.

Sifters. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B-6124—8 pages describing this company's heavy-duty, low-head, gyratory sifters, with particular reference to advantages and applications.

Stacks. Prat-Daniel Corp., Port Chester, N. Y.—Catalog 109—12 pages on this company's Thermix stacks, showing special features, types and typical applications.

Steel. Lukens Steel Co., 107 Lukens Bldg., Coatesville, Pa.—Form 107—12 pages on this company's steel plates, showing sizes that can be produced and advantages in using large plates. Gives standard gages, widths and lengths of sheared and flame-cut plates.

Tubing. Pennsylvania Flexible Metallic Tubing Co., 72d St. and Powers Lane, Philadelphia, Pa.—Bulletins 52-G and 59-G—8-page bulletins describing respectively this company's bronze steam hose and galvanized steel hose, with information on types of construction and advantages.

Tubing. Summerill Tubing Co., Bridgeport, Montgomery Co., Pa.—8-page leaflet on this company's ability to produce special purpose steel tubing, taking as a typical example tubing for hydraulic lines, capable of being flared for use with screwed tubing fittings of the compression type.

Unit Heaters. Reznor Mfg. Co., Mercer, Pa.—Catalog U41—11 pages on this company's new line of gas-fired suspended unit heaters, of fan, blower and duct types. Describes each type, together with accessories. Gives specifications for sizes from 55,000 to 200,000 B.t.u. per hour.

Valve Controls. Philadelphia Gear Works, Erie Ave. & G St., Philadelphia, Pa.—4-page leaflet describing this company's Limitorque valve operator, showing typical applications and listing typical users.

Water Treatment. Water Service Laboratories, 423 West 126th St., New York, N. Y.—4-page reprint of an article on the effects of dissolved gases in water on pipe corrosion, with information on a suggested method of treatment.

Weighing. The Exact Weight Scale Co., Columbus, Ohio—16-page broadside, "The Story of Modern Industrial Weighing," showing applications of weighing equipment and illustrating the broad range of types of scale made by this company.

Welding and Cutting. Air Reduction Sales Co., 60 East 42d St., New York, N. Y.—Form ADG-1074—4-page leaflet on this company's flux-coated bronze welding rods. Also bulletins on gas-cutting machines, including ADC-614A, 12 pages on No. 10 Radiagraph cutting machine; ADC-627, 8 pages on No. 4 Radiagraph; ADC-628, 24 pages on Oxygraph and Travograph gas-cutting machines.

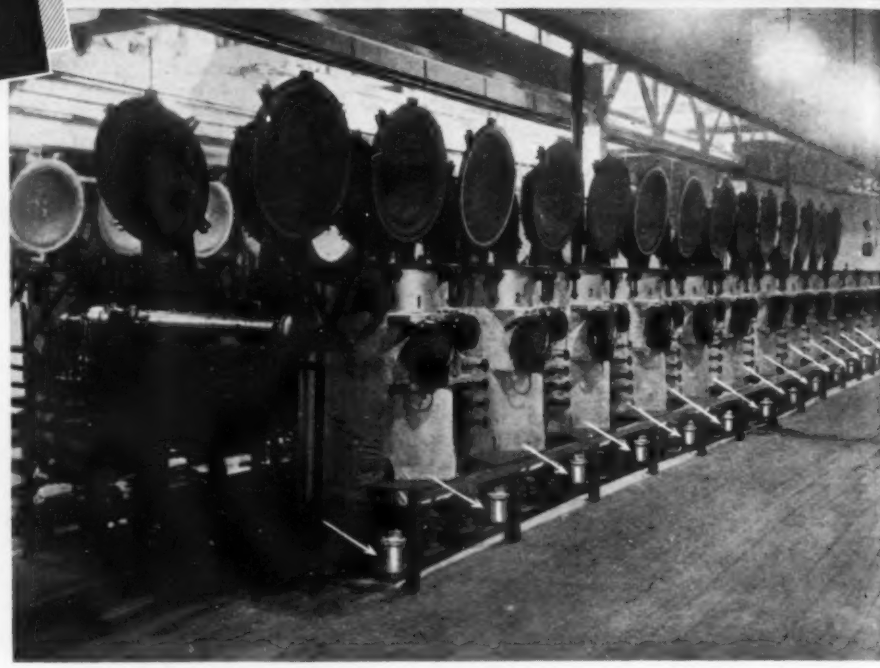
Wire. John A. Roebling's Sons Co., Trenton, N. J.—34 pages on this company's rubber-covered electric wires and cables, with information on production, types and specifications.

ARMSTRONG "*Blast Type*" STEAM TRAPS

for Faster Heating

OF RETORTS, JACKETED KETTLES AUTOCLAVES, PRESSURE COOKERS, ETC.

The picture at the right shows a few of a battery of 84 big retorts that are equipped with Armstrong Blast Type Traps. In each, the vent is set to stay open up to 249°F.

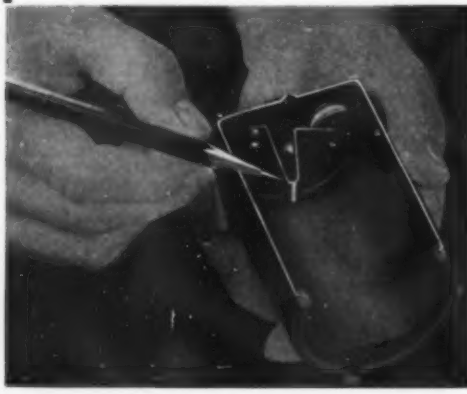


HOW IT WORKS:

THE uncovering of a large opening in the top of trap bucket is controlled by a flat stainless steel disc mounted on the end of a curved strip of non-corroding bi-metal. Different coefficients of expansion cause the strip to open vent when cold and close when hot.

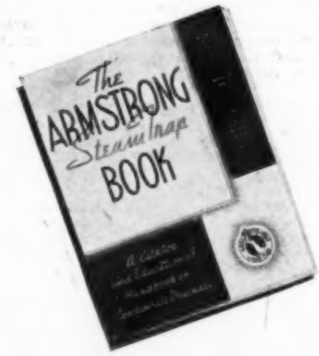
QUICK FACTS:

1. **SIMPLE PRINCIPLE.** Cuts heating-up time by permitting extra fast discharge of any air present in steam space.
2. **LARGE CAPACITY.** Actual tests show 50 to 100 times faster removal of air than with standard traps.
3. **CUTS STEAM COST.** To speed up heating, many operators of equipment drained by ordinary traps habitually open up by-passes to let out air, water (and incidentally steam). This practice can be eliminated when you have Armstrong Blast Type Traps.
4. **ADJUSTABLE AND ACCURATE.** The thermic vent can be set to stay open up to any desired temperature.
5. **SINGLE ORIFICE.** Only one valve seat to be maintained tight against steam pressure. No expansion bellows to collapse.
6. **LOW COST.** Small Armstrong Blast Traps list at $1.50 over standard. The proportionate cost is even lower in the larger sizes. Detailed information will be supplied on request. Write ARMSTRONG MACHINE WORKS, 858 Maple St., Three Rivers, Michigan.



Every Process Plant Engineer Will Want a Copy of this Book

HERE is a new and larger edition of the well-known Armstrong Catalog and Educational Handbook on Condensate Drainage. This 36 page handy reference volume is a veritable encyclopedia of useful information about condensate drainage, heating, pipe sizes, hook-ups, and traps—profusely illustrated with photographs and diagrams and sprinkled with charts and tables. WE WILL BE GLAD TO MAIL YOU A COPY ON REQUEST AND WITHOUT OBLIGATING YOU IN ANY WAY.



Chem & Met ECONOMICS and MARKETS

CHEMICAL CONSUMPTION CLOSED YEAR WITH GAIN OF 15 PER CENT OVER 1939

Despite the relatively high rate of consumption of chemicals in the last quarter of 1939, the rate was even higher during the final three months of last year and for the 12-month period an increase of approximately 15 per cent was registered for 1940. Early January reports indicated that manufacturing schedules are being continued on an undiminished scale and the outlook for the first quarter of the present year is favorable for another record performance. As many consuming industries have been operating at close to capacity, it is evident that the rate of acceleration in the immediate future can not be rapid until the effects of plant expansions have become more of a factor.

Chem. & Met. Index for Consumption of Chemicals

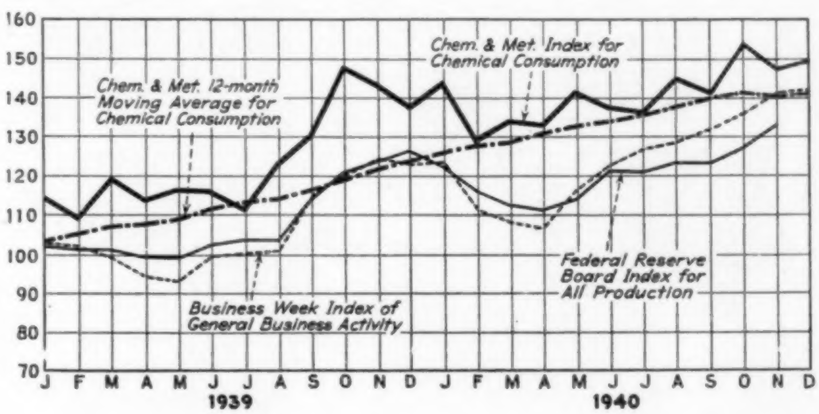
	October revised	November
Fertilizer	31.49	30.75
Pulp and paper	20.80	20.31
Petroleum refining	14.36	13.82
Glass	14.33	13.75
Paint and varnish	12.72	10.37
Iron and steel	12.39	12.25
Rayon	12.78	12.46
Textiles	10.07	9.57
Coal products	9.42	9.37
Leather	4.27	4.22
Explosives	5.49	5.03
Rubber	3.30	3.20
Plastics	3.16	3.00
	154.48	148.10

A high rate of manufacture was in evidence in January last year but this was followed by a slowing down of operations and the index for consumption of chemicals for the first quarter was slightly below 136. Based on present schedules of some of the most important consuming branches, it is probable that the current quarter will see a disappearance of chemicals amounting to close to 15 per cent above that reported for the like period of last year, which would represent only a moderate gain over the volume consumed in the quarter just ended.

The preliminary index for consumption of chemicals in December is 150 which compares with a revised index of 148.10 for November and with 138.42 for December last year. Demand for silk fell below expectations in December with some of the plants reported as closed in the latter part of the month. With this exception, the textile industry has been an important factor in increasing demand for chemicals. In the final months of the year, woolen mills speeded up operations enough to report a gain over the preceding year. Mill consumption of cotton and rayon was of record proportions and with the rise in activities at woolen plants, the textile industry is pointed for a new record in the current quarter. Steel mills also established a new record last year and with greater plant capacity operating the record should prove to be short-lived. Leather production began to broaden in the latter part of the year and while the output of leather in November was smaller than in November 1939, greater activity was reported for the tanning branch.

In the last year, there has been a large gain in the amount of chemicals used in manufacturing explosives. Data for shipments of explosives as issued from government sources evidently refer only to the amounts used in coal mining, construction, and other peace-time industries. This is evident from a comparison of exports of explosives which were far higher last year than in any of the preceding years. In the present year, we will have large outputs of toluol, ammonia, ammonium nitrate, nitric acid, and other chemicals which will pass directly into the munitions industry. To a lesser degree this was true last year and consumption of these chemicals has not been fully reflected in our index. For 1941, the explosives industry, as set up under the defense program, will become one of the important consumers of chemicals with its importance increasing as the different munitions plants come into operation. Hence some adjustment must be made in order to give a complete coverage for consumption in this industry.

Production of fats and oils from domestic materials in 1940 was the largest on record—8.8 billion pounds (tentative estimate) compared with 8.2 billion pounds in 1939. Most of the increase was in lard, inedible tallow and greases, soybean oil, and linseed. Storage stocks of these fats and oils are large. Production from imported materials during the first 9 months of 1940 was about the same as the 727 million pounds produced in the like period of 1939.

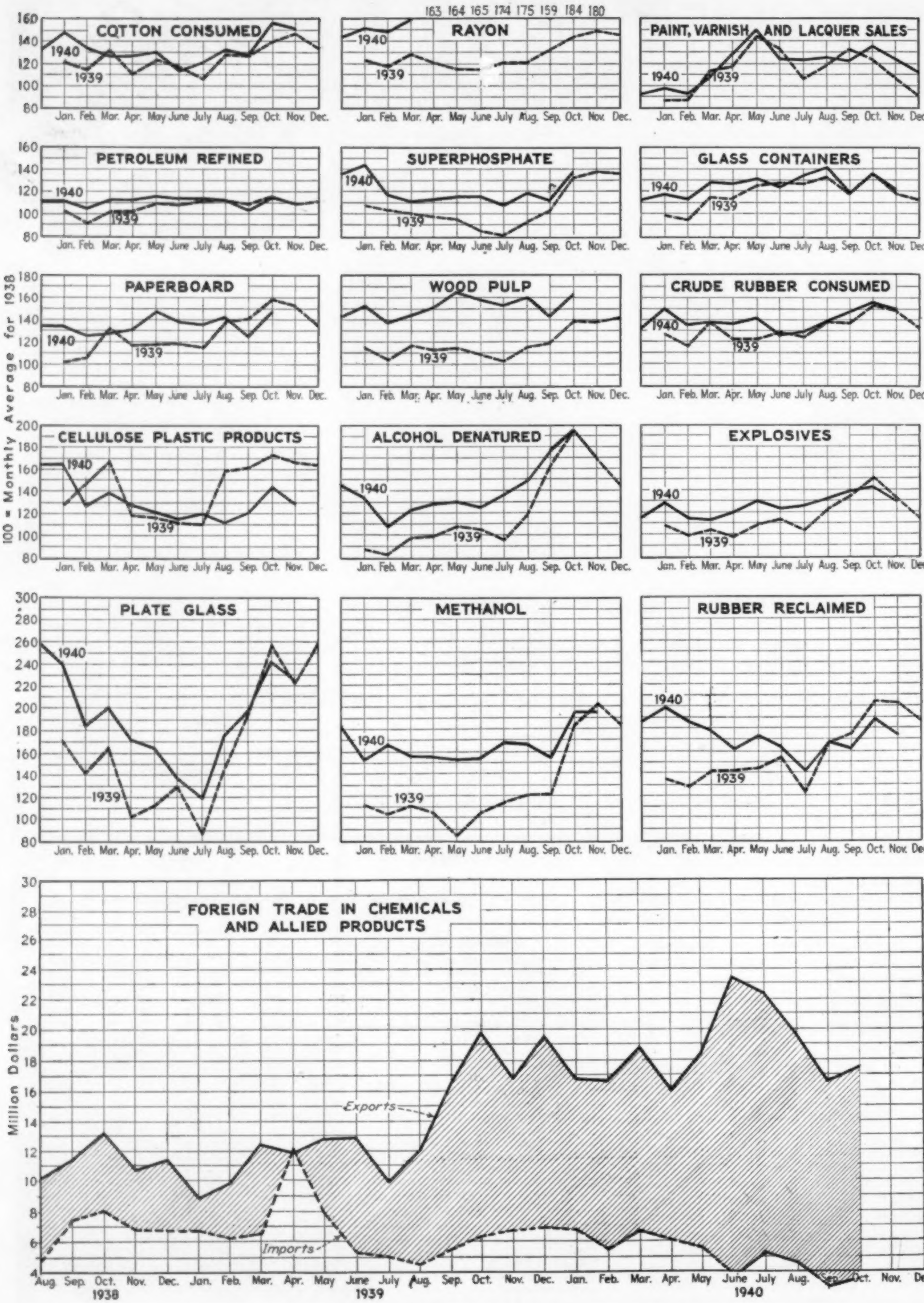


Production and Consumption Data for Chemical-Consuming Industries

Production	Nov. 1940	Nov. 1939	Jan.-Nov. 1940	Jan.-Nov. 1939	Per cent of gain for 1940
Alcohol, ethyl, 1,000 pr. gal	23,354	21,793	231,176	199,548	15.8
Alcohol denatured, 1,000 wi. gal	13,158	13,065	122,022	102,856	18.6
Ammonia liquor, 1,000 lb	4,992	4,868	51,336	43,361	18.4
Ammonia sulphate, tons	62,843	59,925	652,810	519,638	25.6
Benzol, 1,000 gal	11,861	11,498	120,217	93,102	29.1
Byproduct coke, 1,000 tons	4,750	4,552	48,970	38,179	28.3
Toluol, 1,000 gal	2,294	2,098	1	17,599	....
Naphthalene, 1,000 lb	6,867	5,144	1	43,145	....
Glass containers, 1,000 gr	4,352	4,300	50,061	47,181	6.1
Plate glass, 1,000 sq. ft	16,059	15,812	146,880	123,264	19.2
Window glass, 1,000 boxes	1,264	1,143	12,220	9,588	27.5
Methanol, crude, 1,000 gal	467	480	4,810	4,226	13.8
Methanol, synthetic, 1,000 gal	4,440	4,612	41,055	30,071	36.5
Nitrocellulose plastics, 1,000 lb	1,061	1,361	10,808	12,284	11.2*
Cellulose acetate plastics, 1,000 lb.					
Sheets, rods, and tubes	934	725	8,020	8,153	1.6*
Molding composition	1,606	1,199	13,528	10,472	29.2
Rubber reclaimed, tons	17,689	19,417	190,304	172,149	10.5
Consumption					
Cotton, bales	744,088	718,721	7,232,417	6,718,725	7.6
Silk, bales	36,374	32,241	289,754	362,303	20.0*
Wool, 1,000 lb	42,790	35,674	364,505	366,270	0.5*
Explosives, 1,000 lb	34,444	35,477	373,210	341,891	9.2
Rubber, crude, tons	54,652	55,677	562,063	533,161	5.4
Rubber reclaimed, tons	16,042	16,551	170,868	162,671	5.0

* Per cent of decline. 1 Data not available.

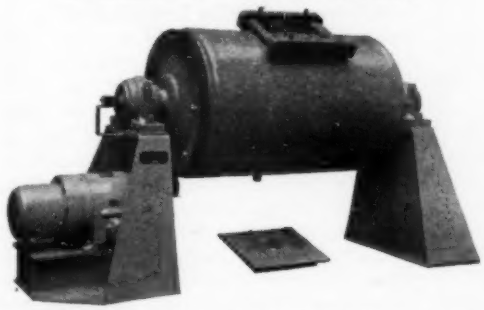
Production and Consumption Trends



ARE YOU LOOKING FOR PROCESS EQUIPMENT
that is properly engineered, expertly designed and ruggedly built?

At this time most industries are depending on steady, uninterrupted production. Breakdowns caused by improperly designed and poorly constructed equipment are not only annoying and costly, but in most cases time and production lost through such mishaps can never be recovered. For this reason plant engineers everywhere are recognizing "PORTER-BUILT" Process Equipment because it is engineered, designed and built to give efficient, faultless and dependable operation, all of which is essential to insure a smooth operating plant. For complete information on any of the equipment illustrated, write for our BULLETIN M-41.

GRINDING & PULVERIZING



THE PORTER BALL and PEBBLE MILLS are ruggedly constructed with rolled steel gears, all steel heads, anti-friction bearings, fabricated welded steel integral motor drive stands and many other features which assure low power and maintenance cost.

BLENDING

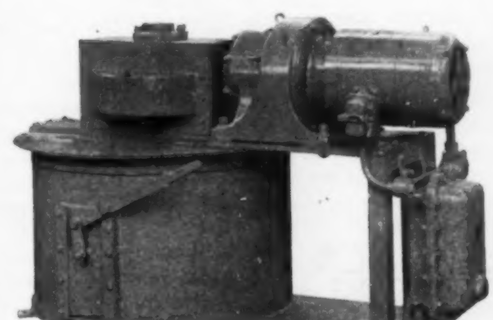
THE PORTER DOUBLE CONE BLENDER is designed for mixing and blending dry powders and crystals into homogeneous mixes of exact proportions. Standard construction features anti-friction bearings and integral drive and bearing support stand.

AGITATORS
MIXERS
BLENDERS
BALL MILLS
KETTLES
AUTOCLAVES
DIGESTERS

MIXING

THE PORTER DOUBLE RIBBON MIXER provides a mixer employing PORTER features throughout to form a strong, compact unit for use in mixing semi-viscous pastes to light fine powders. Double or single ribbons with end or center discharge. Belt or motor drive to customers' requirements.

MIXING-PASTES



THE PORTER PASTE MIXER is designed for the mixing of paints, pastes, and other viscous materials, and features in addition to rugged construction, a complete unit including motor drive and operating controls on a single bed. Charging opening, starter and discharge gate all within easy reach of the operator.

"If it's PORTER-BUILT it's Better Built"

H. K. PORTER COMPANY, INC.
Process Equipment Division
PITTSBURGH, PENNA.
"Where the Famous PORTER LOCOMOTIVES are built"

PRICES FOR CHEMICAL PRODUCTS SHOW FIRM UNDERTONE WITH MODERATE RISING TREND

The average level of prices for chemicals has moved up in recent months and a net gain was recorded for the year. At present there is a firm undertone and the rising trend does not appear to have run its full course. Various factors have been at work to increase values. In the first place consuming demand has been moving up sharply and there has been a marked drop in competitive selling. Then there have been increases in production costs as represented by higher costs for raw materials and increases in wage scales. In the spot market price irregularity has been in evidence for some time in selected items which are in limited supply and transactions have been put through at prices much higher than those openly quoted. This has referred to some chemicals of domestic production as well as to those of foreign origin.

Comparison with the prices quoted a year ago, however, reveals that the majority of the heavy tonnage chemicals have held a steady price course and regular consumers have received supplies without difficulty. It is also noteworthy that contracts for first quarter deliveries have been made in numerous cases without any advance in quotations. At the beginning of the year it was announced that prices for sulphur would be repeated and this gives assurance that the sulphur compounds will not be subject to much in the way of fluctuations. It is also noted that some of the chemicals which are new or comparatively new, have come down in price as their fields of distribution broadened. This is exemplified in a recent announcement that lower prices had been put into effect for a line of rosin esters. The price situation, therefore is mixed with producers attempting to stabilize values and with several conditions pointing to higher costs.

Vegetable oils and animal fats present a different picture. For a long time, prices have held at an unusually low level and as stocks were large, the probability of price recoveries were regarded as remote. Of late, this condition has changed for the better. An improved buying movement has been in evidence and values are now on the way up with trade opinions holding that the upward swing will continue.

Prices for naval stores, particularly spirits of turpentine, have been firmer and the prospects for a continuation of this trend have been increased by the announcement on Dec. 27, that the Commodity Credit Corp. loan program had been authorized by the Department of Agriculture. Accordingly the American Turpentine Farmers Association Cooperatives at Valdosta, Ga. will be the medium through which loans will be disbursed. Farmers who comply with the 1941 conservation program will be entitled to participate. Loan values for this year are on a basis of 30¢ per gal. on turpentine in bulk. This is an increase of 7¢ per gal. over the 1940 figure. On rosin, loan values range from $1.95 per 100 lb. for H grade to $2.45 per 100 lb. for X grade. Loans will not be made on turpentine in barrels or on rosin below G grade.

In line with the defense program, the munitions industry is becoming more important because of the effect it will have on production and distribution of chemicals. The announcement of new plants for producing the needed raw materials and finished products, indicates that such demands will not affect the normal chemical output. In the new Congress there undoubtedly will be a new bill proposing to license those who make, market, or use explosives or certain raw materials from which explosives are produced. But the expected legislation is not likely to be anything as objectionable as that proposed last fall.

Foreign trade in chemical products in the last year has been noted for the sharp rise in outward shipments and a drop in the incoming movement. The import situation shows no indications that it will change materially but export demand should hold above normal levels although the availability of shipping space may upset calculations somewhat. Incidentally higher shipping rates have been important as a price factor on imported materials and this is a condition which may become worse instead of better.

Glycerine supplies in Great Britain have been under scrutiny and steps have been taken to conserve stocks for the industries which are classified as essential. This was prefaced by a survey into all normal fields of consumption. The resultant action has been to give war demands and export trade full requirements. Uses which fall into the category of national importance, including technical and medicinal, are granted an allotment of about two-thirds normal requirements. Others who

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base=100 for 1937

This month	**100.00**
Last month	99.64
January, 1940	98.72
January, 1939	98.88

Higher prices went into effect for spirits of turpentine and sulphate of ammonia. Formerly announced advances for lead and zinc pigments also were applied on January deliveries. Most chemicals are now fixed in price for the first quarter.

normally consume glycerine are being educated to make use of substitute materials.

After first deciding not to paint new barracks, the Army changed its mind in December and ordered more than 800,000 gallons of paint for 41 cantonments. Exteriors of all mobilization type buildings are to be double-coated, to preserve frame and metal surfaces and to enhance the appearance of the camps. The paint order was for 732,332 gallons of cream paint for the buildings, 106,480 gallons of gray paint for doors and sills.

Vitamin B_1 tablets were flown by China Clipper to the Hong Kong-Canton area during December as a new wrinkle in the American Red Cross war relief activities. A total of 60,000 tablets were sent in three plane shipments after reports were received of serious prevalence of beri-beri, and another 100,000 tablets were started by boat around the same time.

The 1940 list of strategic materials still is the official rule of the government. It contains fourteen commodities; but three of them could be removed from the list, namely, tungsten, mercury, and coconut shell char. The government is buying an abundance of activated charcoal for gas masks from companies using domestic raw materials. And the annual report of the U. S. Geological Survey states that this country is now substantially independent of imports for its quicksilver and tungsten needs.

According to a report to the Department of Commerce the Government of Mysore has approved the establishment of a factory to manufacture sodium bichromate, and the State Comptroller has been asked to place at the disposal of the Government Director, the necessary amount for preliminary expenses.

The capital expenditure for a plant capable of producing 1½ long tons daily is estimated at 55,000 rupees ($16,500), exclusive of the cost of crushing and grinding equipment, which may require an extra expenditure of 15,000 rupees ($4,500). In addition, the factory would require a working capital of 70,000 rupees ($21,000). The factory will be located at Belagola in the State of Mysore.

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base=100 for 1937

This month	75.28
Last month	68.94
January, 1940	75.64
January, 1939	78.05

Advances in price were fairly general throughout the list of oils and fats. A better buying movement was in progress. Edible grades also were more active and added to the strength of crude oils.

CHEMICAL processes are being protected in many plants today against contamination by smoke, soot, and dust through the use of electro-static filters—which collect these fine air borne particles electrically!

The American Electro-Matic, which combines electrical precipitation as an integral part of an automatic air filter, is the most advanced air cleaner ever devised. It offers advantages not found in any other type of air filter, and may be operated continuously over long periods without interruptions or shut downs for maintenance.

A detailed description of the Electro-Matic, construction blueprints, efficiency tables, and the interesting story of its development and application are given in Bulletin No. 250C just issued. A copy will be sent you free, without obligation.

Other AAF products particularly applicable to the protection of chemical plant operations include a complete line of air filters of all sizes and types in addition to the Roto-Clone dust collector, which exhausts and collects process dusts simultaneously. Send for bulletin "AAF in Industry."

AMERICAN AIR FILTER CO., INC.
INCORPORATED

145 Central Avenue **Louisville, Kentucky**

AAF ELECTRO·MATIC

Automatic Electrostatic Air Filter

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.07½-$0.08	$0.07½-$0.08	$0.07½-$0.07¾
Acid, acetic, 28%, bbl., cwt	2.23 - 2.48	2.23 - 2.48	2.23 - 2.48
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.25 -10.50	10.25 -10.50	10.25 -10.50
Boric, bbl., ton	106.00-111.00	106.00-111.00	106.00-111.00
Citric, kegs, lb	.20 - .23	.20 - .23	.20 - .23
Formic, cbys., lb	.10½- .11	.10½- .11	.10½- .11
Gallic, tech., bbl., lb	.90 - 1.00	.90 - 1.00	.70 - .75
Hydrofluoric 30% drums, lb	.08 - .08½	.08 - .08½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriatic, 18°, tanks, cwt	1.05 -......	1.05 -......	1.05 -......
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.10¾- .12	.10¾- .12	.10¾- 12
Phosphoric, tech., c'bys., lb	.07½- .08½	.07½- .08½	.07½- .08½
Sulphuric, 60°, tanks, ton	13.00 -......	13.00 -......	13.00 -......
Sulphuric, 66°, tanks, ton	16.50 -......	16.50 -......	16.50 -......
Tannic, tech., bbl., lb	.54 - .56	.54 - .56	.40 - .45
Tartaric, powd., bbl., lb	.50 -......	.43½-......	.31½-......
Tungstic, bbl., lb	nom.	nom.	nom. ......
Alcohol, amyl	......	......	......
From Pentane, tanks, lb	.111-......	.101-......	.101-......
Alcohol, Butyl, tanks, lb	.09 -......	.09 -......	.09 -......
Alcohol, Ethyl, 190 p'f., bbl., gal	6.04 -......	6.04-......	4.54 -......
Denatured, 190 proof			
No. 1 special, bbl., gal. wks.	.31½-......	.31½-......	.29½-......
Alum, ammonia, lump, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Potash, lump, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Aluminum sulphate, com. bags, cwt	1.15 - 1.40	1.15 - 1.40	1.15 - 1.40
Iron free, bg., cwt	1.60 - 1.70	1.60 - 1.70	1.30 - 1.55
Aqua ammonia, 26°, drums, lb	.02½- .03	.02½- .03	.02 - .03
tanks, lb	.02 - .02¾	.02 - .02¾	.02 - .02¾
Ammonia, anhydrous, cyl., lb	.16 -......	.16 -......	.16 - .16
tanks, lb	.04½-......	.04½-......	.04½-......
Ammonium carbonate, powd. tech., casks, lb	.09 - .12	.09 - .12	.09 - .12
Sulphate, wks., cwt	1.45 -......	1.40 -......	1.40 -......
Amylacetate tech., from pentane, tanks, lb	.10½-......	.10½-......	.10½- .10½
Antimony Oxide, bbl., lb	.13 -......	.13 -......	nom. ......
Arsenic, white, powd., bbl., lb	.03½- .04	.03½- .04	.03 - .03½
Red, powd., kegs, lb	.17 - .18	.17 - .18	.15½- .16
Barium carbonate, bbl., ton	52.50 -57.50	52.50 -57.50	52.50 -57.50
Chloride, bbl., ton	79.00 -81.00	79.00 -81.00	79.00 -81.00
Nitrate, casks, lb	.08½- .10	.08½- .10	.07 - .08
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f. o. b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	43.00 -......	43.00 -......	48.00 -51.00
Bromine, cs., lb	.30 - .32	.30 - .32	.30 - .32
Calcium acetate, bags	1.90 -......	1.90 -......	1.90 -......
Arsenate, dr., lb	.06½- .06¾	.06½- .06¾	.06½- .07
Carbide drums, lb	.04½- .05	.04½- .05	.05 - .06
Chloride, fused, dr., del., ton	19.00 -24.50	19.00 -24.50	21.50 -24.50
flake, dr., del., ton	20.50 -25.00	20.50 -25.00	23.00 -25.00
Phosphate, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb	.04½- .05½	.04½- .05½	.04½- .05½
Chlorine, liquid, tanks, wks., lb	1.75 -......	1.75 -......	1.75 -......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.84 - 1.87	1.84 - 1.87	1.84 - 1.87
Copperas, bgs., f. o. b., wks., ton	18.00 -19.00	18.00 -19.00	17.00 -18.00
Copper carbonate. bbl., lb	.10 - .16½	.10 - .16½	.10 - .16
Sulphate, bbl., cwt	4.75 - 5.00	4.75 - 5.00	4.75 - 5.00
Cream of tartar, bbl., lb	.43½-......	.36½-......	.25½-......
Diethylene glycol, dr., lb	.22 - .23	.22 - .23	.22 - .23
Epsom salt, dom., tech., bbl., cwt	1.80 - 2.00	1.80 - 2.00	1.80 - 2.00
Ethyl acetate, drums, lb	.07½-......	.07½-......	.06½-......
Formaldehyde, 40%, bbl., lb	.05½- .06	.05½- .06½	.05½- .06½
Furfural, tanks, lb	.09 -......	.09 -......	.09 -......
Fusel oil, ref. drums, lb	.16 - .17	.16 - .17	.16 - .17
Glaubers salt, bags, cwt	.95 - 1.00	.95 - 1.00	.95 - 1.00
Glycerine, c.p., drums, extra, lb	.12½-......	.12½-......	.12½-......
Lead:			
White, basic carbonate, dry casks, lb	.07½-......	.07½-......	.07 -......
White, basic sulphate, sck., lb	.07½-......	.07½-......	.06½-......
Red, dry, sck., lb	.08 -......	.08 -......	.08 - .....
Lead acetate, white crys., bbl., lb	.11 - .12	.11 - .12	.11 - .12
Lead arsenate, powd., bag, lb	.09½- .11	.09½- .11	.10 - .10½
Lime, chem., bulk, ton	8.50 -......	8.50-......	8.50 -......
Litharge, pwd., csk., lb	.07 -......	.07	.07 -......
Lithophone, bags, lb	.0385 .04	.0385 .04	.036- .04
Magnesium carb., tech., bags, lb	.06½- .06½	.06½- .06½	.06 - .06½

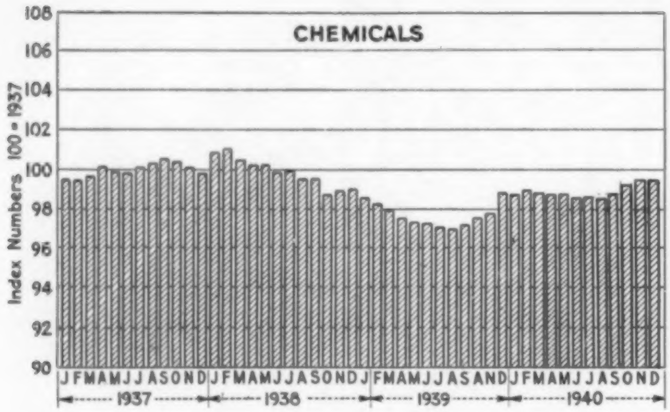
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Jan. 11

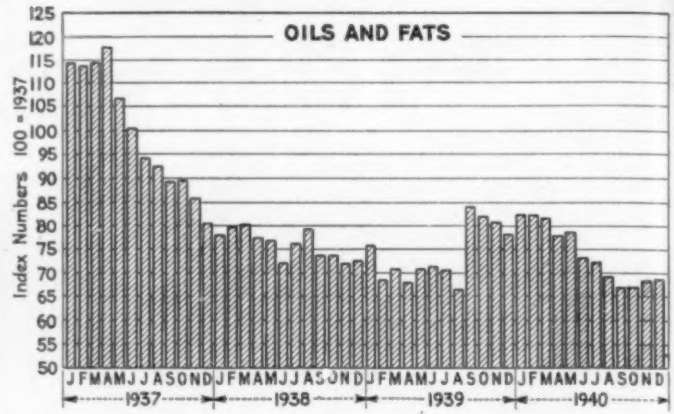
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.29 -......	.29 -......	.31 -......
97%, tanks, gal	.30 -......	.30 -......	.32 -......
Synthetic, tanks, gal	.30 -......	.30 -......	.33 -......
Nickel salt, double, bbl., lb	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.11 -......	.11 -......	.10½-......
Phosphorus, red, cases, lb	.40 - .42	.40 - .42	.40 - .42
Yellow, cases, lb	.18 - .25	.18 - .25	.18 - .25
Potassium bichromate, casks, lb	.08½- .09	.08½- .09	.08½- .09
Carbonate, 80–85%, calc. csk., lb	.06½- .07	.06½- .07	.06½- .07
Chlorate, powd., lb	.10 - .12	.10 - .12	nom. ......
Hydroxide(c'stic potash) dr., lb	.07 - .07½	.07 - .07½	.07 - .07½
Muriate, 80% bgs., unit	.53½-......	.53½-......	.53½-......
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb	.18½- .19	.18½- .19	.18½- .19
Prussiate, yellow, casks, lb	.15 - .16	.15 - .16	.15 - .16
Sal ammoniac, white, casks, lb	.0515 .06	.0515 .06	.05 - .05½
Salsoda, bbl., cwt	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	23.00 -......	23.00 -......	23.00 -......
Soda ash, light, 58%, bags, contract, cwt	1.05 -......	1.05 -......	1.05 -......
Dense, bags, cwt	1.10 -......	1.10 -......	1.10 -......
Soda, caustic, 76%, solid, drums, cwt	2.30 - 3.00	2.30 - 3.00	2.30 - 3.00
Acetate, works, bbl., lb	.04 - .05	.04 - .05	.04 - .05
Bicarbonate, bbl., cwt	1.70 - 2.00	1.70 - 2.00	1.70 - 2.00
Bichromate, casks, lb	.06½- .07	.06½- .07	.06½- .07
Bisulphate, bulk, ton	16.00 -17.00	16.00 -17.00	15.00 -16.00
Bisulphite, bbl., lb	.03 - .04	.03 - .04	.03½- .04
Chlorate, kegs, lb	.06½- .06½	.06½- .06½	.06½- .06½
Cyanide, cases, dom., lb	.14 - .15	.14 - .15	.14 - .15
Fluoride, bbl., lb	.07 - .08	.07 - .08	.07½- .08
Hyposulphite, bbl., cwt	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	2.35 - 2.40	2.35 - 2.40	2.20 - 3.20
Nitrate, bulk, cwt	1.45 -......	1.45 -......	1.45 -......
Nitrite, casks, lb	.06½- .07	.06½- .07	.06½- .07
Phosphate, tribasic, bags, lb	2.25 -......	2.25 -......	2.10 -......
Prussiate, yel. drums, lb	.10½- .11	.10½- .11	.09½- .10
Silicate (40° dr.) wks., cwt	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60–62%, dr., lb	.02½- .03½	.02½- .03	.02½- .03
Sulphite, crys., bbl., lb	.02½- .02½	.02½- .02½	.02½- .02½
Sulphur, crude at mine, bulk, ton	16.00 -......	16.00 -......	16.00 -......
Chloride, dr., lb	.03 - .04	.03 - .04	.03 - .04
Dioxide, cyl., lb	.07 - .08	.07 - .08	.07 - .07½
Flour, bag, cwt	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb	.54 -......	.54 -......	.52 -......
Crystals, bbl., lb	.38 -......	.37 -......	.37 -......
Zinc. chloride, gran., bbl., lb	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl , lb	.14 - .15	.14 - .15	.14 - .15
Cyanide, dr., lb	.33 - .35	.33 - .35	.33 - .35
Dust, bbl., lb	.09½-......	.09½-......	.07½-......
Zinc oxide, lead free, bag., lb	.06½-......	.06½-......	.06½-......
5% lead sulphate, bags, lb	.06½-......	.06½-......	.06½-......
Sulphate, bbl., cwt	3.15 - 3.25	3.05 - 3.25	2.75 - 3.00

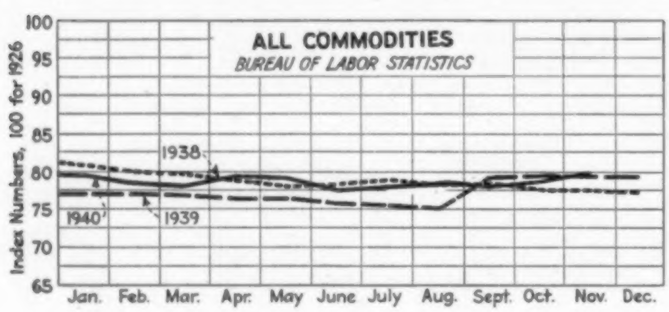
OILS AND FATS

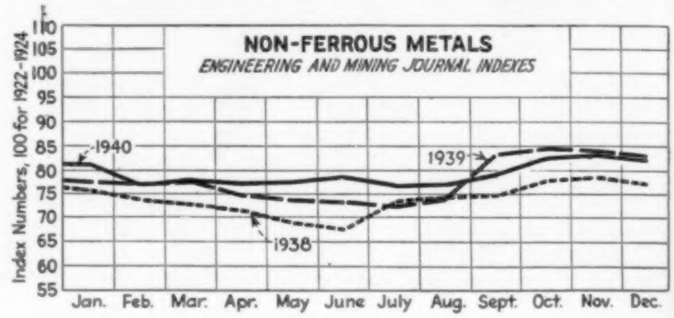
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.10½-$0.11	$0.10½-$0.11	$0.11½-$0.12
Chinawood oil, bbl., lb	.27½-......	.26 -......	.27 -......
Coconut oil, Ceylon, tank, N. Y., lb	.03½-......	.02½-......	.03½-......
Corn oil crude, tanks (f. o. b. mill), lb	.06½-......	.05½-......	.06 -......
Cottonseed oil, crude (f. o. b. mill), tanks, lb	.05½-......	.04½-......	.05½-......
Linseed oil, raw car lots, bbl., lb	.095-......	.087-......	.108-......
Palm, casks, lb	.04½-......	.03½-......	.05½-......
Peanut oil, crude, tanks (mill), lb	.05½-......	.05½-......	.06½-......
Rapeseed oil, refined, bbl., gal	1.00 -......	1.10 -......	1.00 -......
Soya bean, tank, lb	.05½-......	.04½-......	.05½-......
Sulphur (olive foots), bbl., lb	.10 -......	.10 -......	.08½-......
Cod, Newfoundland, bbl., gal	nom.	nom.	nom. ......
Menhaden, light pressed, bbl., lb	.078-......	.074-......	.073-......
Crude, tanks (f. o. b. factory), gal	.30 -......	.30 -......	.36 -......
Grease, yellow, loose, lb	.04½-......	.04½-......	.05 - .....
Oleo stearine, lb	.06½-......	.06½-......	.06½ .....
Oleo oil, No. 1	.06½-......	.05½-......	.07½ .....
Red oil, distilled, d.p. bbl., lb	.06½-......	.06½-......	.09 -......
Tallow extra, loose, lb	.05 -......	.04½-......	.05½-......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 -$0.55	$0.52 -$0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb	.70 - .75	.70 - .75	.70 - .75
Benzoic acid, U.S.P., kgs., lb	.54 - .56	.54 - .56	.54 - .56
Benzyl chloride, tech., dr., lb	.23 - .25	.23 - .25	.23 - .25
Benzol, 90%, tanks, works, gal	.14 -......	.15 - .18	.16 - .18
Beta-napthol, tech., drums, lb	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb	.09½- .10	.09½- .10	.09½- .10
Cresylic acid, dr., wks., gal	.58 - .60	.58 - .60	.58 - .60
Diethylaniline, dr., lb	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluol, bbl., lb	.15½- .16	.15½- .16	.15 - .16
Dip oil, 15%, dr., gal	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb	.25 - .27	.25 - .27	.32 - .36
H-acid, bbl., lb	.45 - .50	.45 - .55	.50 - .55
Naphthalene, flake, bbl., lb	.07 - .07½	.07 - .07½	.05¾- .06
Nitrobenzene, dr., lb	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb	.47 - .49	.47 - .49	.47 - .49
Phenol, U.S.P., drums lb	.12 -......	.13 -......	.13 -......
Picric acid, bbl., lb	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal	1.70 - 1.80	1.70 - 1.80	1.55 - 1.60
Resorcinol, tech., kegs, lb	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb	.33 - .40	.33 - .40	.33 - .40
Solvent naptha, w.w., tanks, gal	.27 -......	.27 -......	.26 -......
Tolidine, bbl., lb	.86 - .88	.86 - .88	.86 - .88
Toluol, drums, works, gal	.30 -......	.30 -......	.27 -......
Xylol, com, tanks, gal	.26 -......	.27 -......	.26 -......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb	.13 - .14	.13- .14	.13 - .17
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb	.028- .30	.028- .30	.02½- .30
Prussian blue, bbl., lb	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb	.11 - .26	.11 - .26	.10 - .26
Chrome green, bbl., lb	.21½- .30	.21½- .30	.21 - .27
Carmine red, tins, lb	4.85 - 5.00	4.85 - 5.00	4.85 - 5.00
Para toner, lb	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb	3.12 - 3.20	3.12 - 3.20	2.70 - 2.90
Chrome yellow, C.P., bbl., lb	.14½- .15½	.14½- .15½	.14½- .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb	.06 - .06½	.06 - .06½	.06 - .06½
Gum copal Congo, bags, lb	.08 - .30	.08 - .30	.06 - .30
Manila, bags, lb	.09 - .15	.09 - .14	.09 - .14
Damar, Batavia, cases, lb	.10 - .22	.10 - .20	.08 - .24
Kauri, cases, lb	.18 - .60	.18 - .60	.18½- .60
Kieselguhr (f.o.b. N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -......	50.00 -......	50.00 -......
Pumice stone, lump, bbl., lb	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb	.03 - .04	.03 - .04	.03 - .04
Rosin, H., 100 lb	2.52 -......	2.44 -......	.... -......
Turpentine, gal	.47 -......	.43 -......	.34½-......
Shellac, orange, fine, bags, lb	.27 -......	.28 -......	.32 -......
Bleached, bonedry, bags, lb	.27 -......	.26 -......	.25 -......
T. N. Bags, lb	.16 -......	.17 -......	.20 -......
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N.Y.), ton	13.75 -......	13.75 -......	13.75 -......

Industrial Notes

CHARLES HARDY, INC., New York, has moved its executive offices from 415 Lexington Ave. to 420 Lexington Ave.

IRON & STEEL PRODUCTS, INC., Chicago, has discontinued its St. Louis branch and will handle that territory from the main office.

AMPCO METAL, INC., Milwaukee, has appointed R. J. Thompson manager of the eastern district with headquarters at 30 Church St., New York. S. C. Lawson will be in charge of the central district with headquarters at 600 S. Michigan Ave., Chicago.

AMERICAN FOUNDRY EQUIPMENT CO., Mishawaka, Ind., is expanding its fabricating plant, adding a new storage building, and an enlarged office building.

BLACK, SIVALLS AND BRYSON, INC., Kansas City, Mo., has opened an office at 30 Rockefeller Plaza, New York, with T. S. Murphy in charge.

GAYLOR CONTAINER CORP., St. Louis, is constructing a factory at Oakland, Calif., which will represent an investment of $600,000 according to Charles E. Baum, Pacific Coast sales manager.

ELGIN SOFTENER CORP., Elgin, Ill., has appointed Robert D. Murphy as district representative in western and central New York with headquarters in the Brisbane Bldg., Buffalo.

SKF INDUSTRIES, INC., Philadelphia, is extending its manufacturing space at Bridge St. and adding to its office facilities at Front St. and Erie Ave.

ARIDYE CORP., subsidiary of Interchemical Corp., New York, has added W. Hansot to the organization in a merchandising capacity.

KOPPERS CO., Pittsburgh, has liquidated its subsidiary, The Wood Preserving Co., and from the first of the year its business will be conducted as a division of the parent company.

JOHN A. ROEBLING'S SONS CO., Trenton, N. J., has appointed W. K. Hanna manager of its Pittsburgh territory and has made Horace E. Thorn manager of its Philadelphia office.

MONSANTO CHEMICAL CO., St. Louis, has transferred Clare F. Trombley from Everett, Mass., to the New York office where he is serving as assistant general branch manager.

He *has* to take chances

A policeman never knows what dangers may be lurking in the shadows of his beat. He accepts peril, risks his life, takes chances as his duty.

Dangers lurk, too, in the path of every product that is shipped in drums. Dangers that may imperil a fine product and a cherished reputation. Yet no chances need be taken. Shipments can be made with safety, with confidence, with no risk to a single drop —in Tri-Sure-equipped drums.

Tri-Sure Closures eliminate all the hazards a shipment can face—tampering, pilferage, substitution, leakage and waste—because the Tri-Sure seal cannot be removed unless it is deliberately destroyed, the Tri-Sure plug is always held tightly in place, the Tri-Sure flange assures complete drainage.

Don't take chances with your next shipment. You don't have to. Ship the *sure* way —the Tri-Sure way—and protect your product, your reputation and your customers. Write for information on Tri-Sure Closures.

Tri-Sure

Reg. U. S. Pat. Off.

CLOSURES

AMERICAN FLANGE & MANUFACTURING CO., INC.
30 Rockefeller Plaza, New York

Chem & Met New CONSTRUCTION

	Current Projects Proposed Work	Current Projects Contracts	Cumulative 1940 Proposed Work	Cumulative 1940 Contracts
New England	$40,000	$200,000	$860,000	$1,824,000
Middle Atlantic	2,000,000	1,055,000	14,310,000	19,615,000
South	....	90,000	16,575,000	52,270,000
Middle West	250,000	1,090,000	21,645,000	8,735,000
West of Mississippi	3,680,000	1,065,000	31,850,000	36,143,000
Far West	500,000	40,000	5,490,000	4,578,000
Canada	170,000	90,000	31,055,000	22,611,000
Total	$6,640,000	$3,630,000	$121,785,000	$145,776,000

PROPOSED WORK

Ark., Waterloo—Williams Roofing Co., Little Rock, plans to rebuild its plant here recently destroyed by fire.

Mass., Peabody—A. C. Lawrence Leather Co., Sawyer St., will soon award the contract for alterations and additions to Buildings A and Q.

N. J., Bound Brook—Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., plans to construct a 250x580 ft. factory building here for the manufacture of Vinylite. Estimated cost will exceed $1,000,000.

N. J., New Brunswick—Wallace Laboratories, 300 Communipaw Ave., Jersey City, N. J., will soon award the contract for a 1 and 2 story, 150x370 ft. manufacturing plant, boiler house, etc., here. Albert Kahn, Inc., 345 New Center Bldg., Detroit, Mich., Archt. and Engr. Estimated cost $500,000.

O., Ironton—Alpha Portland Cement Co. plans to improve and enlarge its plant here. Estimated cost $250,000.

Ore., Portland—Pennsylvania Salt Co., of Washington, Tide Flats, Tacoma, Wash., plans to construct an electrolytic chlorate plant on N.W. St. Helens Rd., near St. Johns bridge. Estimated cost $500,000.

Pa., Bethlehem—Bethlehem Steel Co., Bethlehem, plans to construct coke ovens, open hearth furnaces and blast furnaces. Estimated cost will exceed $500,000.

Tex., Corsicana—City of Corsicana plans to construct a municipal gas distributing system and booster station plant. Estimated cost $400,000.

Tex., Katy—Humble Oil & Refining Co., Humble Bldg., Houston and Baytown; Stanolind Oil & Gas Co., and others plan to construct a recycling plant for producing natural gasoline in the Katy gas fields to have a capacity of 200,000,000 cu. ft. a day. Estimated cost $2,750,000.

Tex., McAllen—McCollum Exploration Co., c/o J. B. McCollum, Pres., Houston, plans to construct a recycling plant in the vicinity of McAllen. Estimated cost $450,000.

Tex., Texas City—Pan-American Production Co., subsidiary of Pan-American Oil & Refining Co., Texas City, plans to construct a recycling plant in the vicinity of Texas City.

B. C., Vancouver—Western Chemical Industries, Ltd., Lapointe Pier, plans to construct a processing plant. Estimated cost $40,000.

Ont., Sarnia—Foam Soap Co., Ltd., Valparaiso, Md., plans to construct a plant here.

Que., St. Johns—Kraft Paper Products, Ltd., St. Johns, plans to construct an addition to its plant here. Estimated cost $50,000.

Que., St. Johns—Onyx Oil & Chemical Co., Ltd., plans to construct an addition to its plant here. Estimated cost $40,000.

CONTRACTS AWARDED

Ala., Wilson Dam—Tennessee Valley Authority, Knoxville, Tenn., has awarded the contract for design and supervision of construction for a synthetic ammonia plant to Stone & Webster Engineering Corp., 90 Broad St., New York, N. Y. Estimated cost $6,500,000.

Ill., Clearing—Owens-Illinois Glass Co., Ohio Bldg., Toledo, O., has awarded the contract for a warehouse here to Hughes-Foulkrod Co., 1505 Race St., Philadelphia, Pa. Estimated cost $200,000.

Ill., Wood River—Shell Oil Co., Chicago, Ill., has awarded the contract for a solvent extraction plant at Wood River, Ill., to E. B. Badger & Sons Co., 75 Pitts St., Boston, Mass. Estimated cost $550,000.

Ind., Charlestown—War Dept., 20th and Constitution Ave., N. W., Wash., D. C., has awarded the contract for the construction and operation of a plant for the manufacture of smokeless powder at the Indiana Ordnance Works, to E. I. du Pont de Nemours & Co., du Pont Bldg., Wilmington, Del. Estimated cost $23,000,000.

La., Jefferson Island—Jefferson Island Salt Mining Co., Inc., Columbia Bldg., St. Louis, Mo., will reconstruct and reequip its plant here. Work will be done by owners under supervision of Allen & Garcia Co., 332 South Michigan Ave., Chicago, Ill. Estimated cost will exceed $40,000.

Md., Elkton—National Fireworks Co., West Hanover, Mass., has awarded the contract for reconstructing its factory building here to Foundation Co., 120 Liberty St., New York, N. Y. Estimated cost will exceed $40,000.

Mo., St. Louis—Monsanto Chemical Co., 1700 South Second St., has awarded the contract for an addition to its plant at 1728 South Third St., St. Louis, to Fruin-Colnon Contracting Co., 408 Olive St., St. Louis. Estimated cost including equipment $40,000.

N. H., Nashua—Johns-Manville Corp., 40 Bridge St., has awarded the contract for a 1 and 2 story, 50x640 ft. warehouse to George Belanger & Son, Inc., 308 Main St., Nashua. Estimated cost will exceed $200,000.

N. J., Bound Brook—Bakelite Corp., River Rd., has awarded the contract for a factory and warehouse to Turner Construction Co., 420 Lexington Ave., New York, N. Y. Estimated cost will exceed $150,000.

N. J., Gloucester—Sherwin-Williams Co., Gloucester, has awarded the contract for 50x195 ft. and 28x180 ft. factory buildings here to H. E. Baton, Inc., 1713 Sansome St., Philadelphia, Pa. Estimated cost $50,000.

N. M., Deming—Newell-Pitt Corp., 1016 Suisman St., (North Five), Pittsburgh, Pa., will construct a 400-ton manganese mill at Lake Valley and a 500-ton mill at Deming with its own forces. Estimated cost $500,000.

N. Y., Niagara Falls—National Carbon, Inc., Highland Ave., Niagara Falls, has awarded the contract for a 1 story, 70x400 ft. factory to DeHamel Construction Co., Citizens Bldg., Cleveland, O. Estimated cost $100,000.

O., Akron—General Tire & Rubber Co., 1708 East Market St., has awarded the contract for a 4 story factory and warehouse addition to Carmichael Construction Co., 148 East Miller St., Akron. Estimated cost $300,000.

O., East Liverpool—Hall China Co., East Liverpool, has awarded the contract for a 160x180 ft. addition to its plant to Potters Lumber Co., East Liverpool. Estimated cost $40,000.

O., Sandusky—War Dept., 20th and Constitution Ave., N. W., Wash., D. C., has awarded the contract for the construction and operation of TNT and DNT plant, to be known as Plumb Brook Ordnance Plant, Sandusky Bay, to Trojan Powder Co., Hunsicker Bldg., Allentown, Pa. Estimated cost $10,725,000.

Pa., Bethlehem—Air Reduction Co., 60 East 42nd St., New York, N. Y., has awarded the contract for an oxygen plant here to E. C. Machin Co., Commonwealth Bldg., Allentown. Estimated cost $100,000.

Pa., Cranberry—F. Arthur Johnson, Kane, and J. O. Breene, Oil City, will construct pressure plants in Cranberry Township. Work will be done by day labor and separate contracts. Estimated cost will exceed $75,000.

Pa., Pittsburgh—Prest-O-Lite Co., Inc., McKees Rocks, Pa., has awarded the contract for a 1 story hydrogen building to B. A. Groah Construction Co., 847 West North Ave., N. S.

Tenn., Milan—War Dept., 20th and Constitution Ave., N. W., Wash., D. C., has awarded the contract for an ammunition loading plant at Wolf Creek Ordnance plant on 21,000 acre site near here, to Procter & Gamble Defense Corp., Gwynne Bldg., Cincinnati, O. Estimated cost $15,000,000.

Tex., Aransas Pass—United Carbon Co., Union Bldg., Charlestown, W. Va., will construct an additional unit at its carbon black plant here. Work will be done by owner. Estimated cost $300,000.

Tex., Edinburg—Gulf States Oil Co., c/o P. Kyser, Pres., will construct a 36,000,000 cu. ft. daily capacity gas distillate recycling plant in this area. Work will be done by force account and subcontract. Estimated cost $225,000.

Utah, Jensen—Equity Oil Corp., Utah Oil Bldg., Salt Lake City, will construct a 1,000 bbl. capacity oil refinery here. Work will be done by day labor.

W. Va., Alloy—Electro-Metallurgical Co., Alloy, has awarded the contract for the construction of a plant to Hughes-Foulkrod Co., 1505 Race St., Philadelphia, Pa. Estimated cost will exceed $50,000.

Ont., Hamilton—Canadian Liquid Air Co., Ltd., 18 Boler St., Toronto, has awarded the contract for reconstructing its factory to A. E. Rule, 100 Humbercrest St., Toronto. Estimated cost $40,000.

Sask., Regina—Department of National Defence, Ottawa, Ont., has awarded the contract for the construction of an explosives building here to Bird Construction Co., Ltd., Seventh Ave., Regina. Estimated cost $50,000.